Environmental Investigation Work Plan

for

Gowanus Canal Superfund Site

Brooklyn, New York

Prepared for:

The New York City Department of Environmental Protection

59-17 Junction Blvd, 11th Floor

Flushing, NY 11373

Prepared by:

Louis Berger & Associates, PC

199 Water Street, 23rd Floor, NY, NY

Tel. (212) 612-7900

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Overview

On March 2, 2010, United States Environmental Protection Agency (USEPA) listed the Gowanus Canal on its National Priorities List (NPL) for hazardous wastes. USEPA has identified the three former manufactured gas plant (MGP) sites, and the New York City (hereafter referred to as the City) combined sewer overflows (CSOs) as major sources of contamination to the Canal.

The USEPA states in its draft remedial investigation and feasibility report (RI/FS) that the CSOs are an ongoing contaminant source and will affect the proposed remedy of the Canal if CSO reduction measures, in addition to the existing reduction under the New York State Department of Environmental Conservation (NYSDEC) Consent Order, are not implemented. The City has expressed concerns regarding the data and analysis conducted by USEPA to reach this conclusion. In meetings with USEPA Region 2 and USEPA headquarters, the City has demonstrated the need for additional data collection and further analyses of the impact of CSOs on the Canal. The City therefore plans to conduct a study to determine the concentrations of contaminants of potential concern (COPC) in CSO effluent. Furthermore, City's evaluation of the whole water data collected by the USEPA shows that there is a potential impact of the MGP sites – specifically the Fulton Site on the City CSOs. The City plans to conduct a study that will assess the impact of the Fulton MGP site on the CSOs.

The City is also concerned about the project remediation goal (PRG) developed by USEPA for this site. USEPA has proposed a PRG of 7.8 parts per million (ppm) Total Polycyclic Aromatic Hydrocarbons (PAH) based on test results using the organism, Leptocheirus plumulosus. However, the City has recognized several sources of uncertainty in the execution of these tests and has expressed its concerns in several technical meetings with USEPA. Given the uncertainties in USEPA's dataset, the City plans to re-sample the reference stations and the Gowanus Canal stations for toxicity testing. The City will use data from the new samples to re-calculate a PRG based on sediment toxicity.

This environmental investigation Work Plan developed by the City is designed to collect data to characterize the following:

- The concentrations of COPCs in CSO effluent, both on the solids and in dissolved phase
- Solids and chemical mass balances in the Canal,
- The impact of Fulton MGP site or other NAPL sources on the CSOs, and
- The toxicity of PAHs in Canal sediments to invertebrates (specifically the organism Leptocheirus plumulosus).

These data may be used to support the selection of remedial alternatives to potentially mitigate or reduce risks in accordance with the requirements of the National Contingency Plan (NCP) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

WORK PLAN CONTENT

This Work Plan is organized into nine sections, including references and a glossary of abbreviations.A brief description of each section follows.

Section 1.0, **INTRODUCTION**, presents a brief overview of the description of the study, and the organization and content of the Work Plan.

Section 2.0, SITE BACKGROUND AND SETTING, presents the background of the site including location, climate, site hydrology and hydrogeology, history, and summaries of prior environmental investigations.

Section 3.0, DATA USE OBJECTIVES, discusses the Data Quality Objectives (DQOs) for the sampling and analytical activities, and the approach for preparing the Work Plan, which illustrates how the activities will satisfy data needs.

Section 4.0, STUDY TASKS, presents a proposed scope for each task of the proposed sampling and studies.

Section 5.0, PROJECT SCHEDULE, presents the anticipated schedule for the proposed tasks.

Section 6.0, PROJECT MANAGEMENT APPROACH, presents project management considerations that define relationships and responsibilities for selected task and project management teams.

Section 7.0, REFERENCES, provides a list of references used to develop material presented in this Work Plan.

Section 8.0, GLOSSARY OF ABBREVIATIONS, provides a glossary of abbreviations and acronyms used in this Work Plan.

In accordance with the USEPA procedures, the following applicable planning documents are being prepared in addition to the preparation of this Work Plan:

- Quality Management Plan (QMP) in accordance with "USEPA Requirements for Quality Management Plans" (USEPA/240/B-01/002, March 2001)

- Field Sampling Plan (FSP), a

- Health and Safety Plan (HASP),

- Quality Assurance Project Plan (QAPP).

- Sample Analysis and Validation Tracking: a data and document management system including field logs, sample management tracking procedures, and document and inventory controls for laboratory data and field measurements.

The FSP and the QAPP outline the detailed sampling and analytical procedures for each medium to be sampled, the number and type of each sample and the Quality Assurance/Quality Control (QA/QC) sample requirements for each medium. The DQOs for each sample type are identified in the QAPP based on the required analytical sensitivity for the intended use of the data. The QAPP identifies precision, accuracy and completeness goals used in selecting the sampling and analysis methods. The FSP contains details of field activities, such as Standard Operating Procedures (SOPs) for sediment core collection and processing. These documents are submitted under separate cover from this Work Plan. This work plan is intended to outline the first season of studies to be conducted by the City in detail. The details of additional studies by the City will be provided in subsequent work plans, taking into account where possible the results of this first effort.

SITE BACKGROUND AND SETTING

SITE LOCATION

Gowanus Canal is located in the Borough of Brooklyn, Kings County, New York. The Canal is situated in the Gowanus neighborhood of south Brooklyn. This neighborhood is surrounded by residential neighborhoods, including Boerum Hill, Park Slope, Red Hook, Carroll Gardens, and Cobble Hill. Figure 1 depicts the location of the Study Area.

The Canal is a brackish, man-made, tidal arm of the New York-New Jersey HarborEstuary. The Canal was constructed in the mid-19th century by bulk heading and dredging a previously existing tidal creek and wetland. The historical surface water elevation of this former tidal creek and wetland system is coincident with the current groundwater table elevation of the Gowanus Canal basin, based on City's analysis. This suggests that the Canal is in direct hydraulic communication with the groundwater. The Canal is approximately 7,800 feet long, starting just southwest of ButlerStreet (head end), extending past the Gowanus Expressway, and finally emptying into the GowanusBay. The Canal is approximately 100 feet wide from the head end to 12th street. Downstream of 12th Street, the Canal becomes wider with widths ranging from 150 to 600 feet. Four barge basins, totaling approximately 2,000 feet in length, extend from the main channel on the eastern side at 4thStreet, 6th Street, 7th Street, and 11th Street.

Topography and Drainage

The Gowanus Canal is part of Long Island, New York and is situated within the Atlantic Coastal Plain physiographic province. Topographic elevations in the vicinity of the Project Properties range from approximately 1 foot above sea level on the properties immediately adjacent to the Canal to approximately 20 feet, a greater distance from the Canal (USEPA, 2009). The Canal roughly follows the former Gowanus Creek, which, because of the construction of the Canal, no longer exists.

Historically, surface water within the Gowanus Creek watershed flowed toward, and discharged to, the Gowanus Creek and associated tidal wetland complex. The Gowanus Canal and Bay watershed is now completely urbanized and although direct storm water runoff from upland areas adjacent to the Canal still occurs, urbanization within the watershed has altered the natural topographic drainage (catchment area) to the Canal.

Climate

The climate for Kings County is classified as temperate. High summer temperatures average from 79 to 84 degrees Fahrenheit, with 16 to 19 days exceeding 90 degrees per year. Average winter temperatures in January, typically the coldest month on average, are 32 degrees Fahrenheit, with several days often reaching temperatures as low as 10 degrees Fahrenheit.

Four National Weather Service rain gauges in the metropolitan New York City area surround Gowanus Canal. Records from these rain gauges, including measurements from 1955-2011 at Central Park, LaGuardia Airport and Newark Airport, and measurements from 1970-2011 at John F. Kennedy (JFK) Airport, were analyzed using USEPA's "SYNOP" statistical package. Results are summarized in Table 1. As shown, the average annual precipitation is about 44 inches. The average number of storms (defined as any rain event of at least 0.01 inches having no more than four consecutive dry hours) is about 116 per year, and the average storm size is about 0.38 inches. Average storm intensity is approximately 0.057 inches per hour, and average storm duration is about 6.5 hours.

Figure 2 graphically demonstrates the year-to-year variability of the annual storm statistics in the area. Each blue diamond represents the average parameter value for a particular year in the 1955-2011 record at LaGuardia Airport. The results are ranked from lowest to highest, with percentile values for each ordinate parameter shown on the abscissa. Also shown for reference purposes are the parameter values associated with New York City Department of Environmental Protection's (NYCDEP) present "standard" rainfall record used for CSO facility planning (the actual rainfall measured during 1988 at JFK Airport). A comprehensive discussion of CSOs in the watershed is presented in Section 2.2.2 .

Figure 3 presents the variation of average monthly rainfall and storm statistics for the 1955-2011 periods at LaGuardia Airport. On average, monthly rainfall values are distributed fairly evenly over the year, with July and August typically elevated by 15 to 20 percent above the average, and January and February typically depressed by about the same margin below the average. However, storm characteristics do tend to vary seasonally. Storms tend to occur more frequently in spring, with May having about 20 percent more storms than average, and less frequently in the fall, with October having about 20 percent fewer storms than average. On average, storm sizes tend to be greatest from August through October, though time between storms tends to peak in October. Shorter, more intense storms tend to occur in the summer, while precipitation tends to be lighter and last longer during the winter.

Geology

The general geology beneath the Gowanus Canal study area includes the following materials in order of increasing depth:

- Fill
- Alluvial/Marsh deposits
- Glacial deposits with morainal and ground till and outwash
- Gardiners Clay
- Jameco Gravel

- Fordam Gneiss

The following discussion of regional geology is presented in from the deepest geologic unit to the shallowest.

Bedrock observed at the adjoining Carroll Gardens/Public Place site is the Fordam Gneiss [GEI Consultants, Inc. (GEI), 2005], which is described as a Precambrian Age metamorphosed, medium to coarse-grained igneous rock unit (Brock and Brock, 2001). Regional down warping of bedrock resulted in a southeast-dipping bedrock surface of approximately 80 feet per mile (USEPA, 2003; Cartwright, 2002). Bedrock elevations near the Gowanus Canal range between –100 feet National Geodetic Vertical Datum (NGVD) to –200 feet NGVD (Buxton, *et.al,* 1981). Bedrock was observed in borings drilled at the Carroll Gardens/Public Place adjacent to the Canal at elevations of -127 feet NGVD to -156 feet NGVD.

Within Kings County, bedrock is generally overlain by unconsolidated late Cretaceous age deltaic deposits (Clay Member of the Raritan Formation), overlain by Pleistocene age channel fill (Jameco Gravel) and lagoonal marine deposits (Gardiner's Clay), overlain by Upper Pleistocene (Wisconsin) age glacial deposits and Holocene age marsh/alluvial deposits and artificial filling (Cartwright, 2002). However, Cretaceous-aged Clay Member of the Raritan Formation occurs outside of the Gowanus Canal watershed to the southeast (where it lies unconformably on bedrock) (Buxton and Shernoff, 1999). The Pleistocene-aged Jameco Gravel and Gardiner's Clay unconformably overlie bedrock beneath the study area (Cartwright, 2002). The Jameco Gravel is described as a channel fill deposit associated with the ancestral Hudson River channel scour of southern Kings and Queens Counties. The unit consists of dark coarse sand and gravel with cobbles and boulders and ranges in thickness from absent to approximately 200 feet thick in Queens County (Cartwright, 2002). The approximate elevation of the surface of the Jameco

Gravel ranges between –100 feet NGVD and –150 feet NGVD beneath the Carroll Gardens/Public Place site in the middle reach of the canal and vicinity and slopes toward the southeast (Buxton, Soren, Posner and Shernoff, 1981). The northern/western extent of the Jameco Gravel is located in close proximity to the site, so the gravel is absent under some potions of Gowanus Canal watershed, and potentially absent beneath some of the canal itself (Buxton, Shernoff, 1999). For the most part, where the Jameco Gravel exists in the Gowanus Canal watershed, it is covered by the Gardners Clay. The Gardiners Clay is a lagoonal marine deposit and consists of greenish-gray clay and silt with inter-bedded sand and ranges in thickness from absent in northern and western Kings County to upwards of 100 feet to areas to the southeast and east of the Gowanus Canal (Cartwright, 2002). The Gardners Clay is absent in portions of the Gowanas Canal watershed and beneath portions of the canal itself (Buxton, Shernoff, 1999).The approximate elevation of the surface of the Gardiner's Clay ranges from less than –100 feet NGVD to greater than –100 feet NGVD beneath the project area and slopes toward the southeast (Buxton, Soren, Posner, and Shernoff, 1981). Figure 4 is a map showing the extent of the Jameco Gravel and Gardeners Clay relative to the Gowanus Canal (Buxton, Shernoff, 1999).

The Upper Pleistocene deposits overlie the Gardners Clay and potentially at limited locations, the Jameco Gravel deposits beneath the canal. North and west of the canal, they lie directly on the bedrock. Glacial deposits in the vicinity of the Gowanus Canal consist of terminal moraine to the south and east and ground moraine deposits, which consist of poorly sorted mixtures of clay, silt, sand, gravel, and boulders, and glaciofluvial outwash deposits consisting of moderately to well-sorted sands and gravels and typically range in thickness between 100 and 200 feet (Cartwright, 2002). Based on the historical presence of wetlands in the region, Holocene age marsh deposits consisting of sand, silt, organic material are present along stream channels and marshes. These deposits are not uniformly deposited in the area, with a maximum thickness of about 50 feet within limited areas of Kings and Queens County (Busciolano, 2002).

According to the New York City Soil Survey, soils within the immediate vicinity of the Canal are mainly classified as pavement and buildings: wet substratum-Laguardia-Ebbets complex, 0 to 8 percent slopes, which is defined as "nearly level to gently sloping urbanized areas filled with a mixture of natural soil materials and construction debris over swamp, tidal marsh, or water; a mixture of anthropogenic soils which vary in coarse fragment content, with up to 80 percent impervious pavement and buildings covering the surface" (New York City Soil Survey, 2009).

Shallow unconsolidated soils in the study area (typically to depths of 15 – 35 feet below grade surface [bgs]) are composed of layers of fill material, brown silty sand, dark brown to black/gray silty sand, and organic deposits, all with varying amounts of clay and gravels. Fill materials are a mixture of various amounts of metal fragments, cement, brick, concrete and/or wood.

Regional Hydrogeology

Four regional groundwater aquifers are present in the Long Island area, in order of increasing depth:

- The Upper Glacial Aquifer consisting of Upper Pleistocene glacial deposits. Localized Holocene marsh and alluvial deposits (including clayey and silty deposits) are also grouped in the Upper Glacial Aquifer. These materials are typically less permeable than the underlying aquifers and may create locally confined conditions (Busciolano, 2002).
- The Jameco Aquifer consisting of the Jameco gravel
- The Magothy Aquifer consisting of the Late Cretaceous Magothy Formation and Matawan Group deltaic deposits
- The Lloyd Aquifer consisting of the Lloyd Sand Member

Of these, only the Upper Glacial and the Jameco Aquifers are present in the Gowanus Canal watershed. The Upper Glacial Aquifer is the main aquifer underlying the Canal and surrounding uplands. This unit is generally unconfined (water table); however, it can be locally confined by the presence of silt and clay layers within moraine deposits. In the Gowanas Canal watershed, groundwater within the Upper Glacial Aquifer flows toward the canal.

Current shallow groundwater is typically within 20 feet bgs and flows within the fill unit, alluvial/marsh deposits and upper portions of the Upper Glacial deposits from the upland area towards the Canal. However, based on a review of historical groundwater elevations in the region, groundwater flow direction has varied greatly dating back to the early 1900's and flows for long periods of time were reversed where water from the canal recharged the shallow aquifer. Figures 5 through 13 depict regional groundwater elevation contours for Kings and Queens Counties based on several published sources [Buxton et al, 1981, United States Geological Survey (USGS), 1997; USGS, 2006].

Figure 5 (1903), is an estimate of groundwater conditions when there was limited pumping influence in the region. It is often interpreted as a "natural" groundwater flow regime with groundwater depths similar to that observed today in the area. Under this limited pumping regime, in 1903, it is estimated that there were several million gallons per day being withdrawn from the groundwater in Kings and Queens counties combined.

First evident in the 1936 mapping effort (Figure 6) and continuing through the 1970's (Figure 7), heavy groundwater pumping northeast of the Canal by the Jamaica Water Supply Company created a large cone of depression that greatly influenced groundwater elevations in the region. This pumping activity resulted in estuarine Canal water recharging groundwater and groundwater at the Canal flowing to the northeast with groundwater elevations measured as low as -18.5 feet above mean sea level (AMSL) adjacent to the Canal (Figure 14). Pumping withdrawals near the canal began to reduce in the 1950s and 1960's (Figures 8 and 9), and the water table began to recover (Figures 10 through 13). However, until the groundwater levels near the canal were higher than mean sea level, groundwater did not discharge to the canal and instead canal water continued to recharge groundwater. Groundwater withdrawals had diminished enough by the early 1980's that the groundwater levels began to increase to above the canal water level and, so groundwater likely began to discharge to the canal (Cartwright, 2002). By 1991, the USGS estimated that about 0.5 cubic feet per second were discharging to canal (Misut and Monti, 1999). As presented on Figure 13, groundwater in the upland areas surrounding the Canal flows towards and discharges to the Canal. Immediately adjacent to the Canal and in upland areas surrounding the Canal, groundwater is typically encountered from 6 to 18 feet bgs. Current estimates of groundwater discharge to the Canal are about 2 cubic feet per second. Note that the USGS 2006 Groundwater Contour Map did not present the 5 foot MSL groundwater contour; however, this contour was inferred from the USGS monitoring well data.

SITE HISTORY

After its completion in the 1860s, the Canal quickly became one of the nation's busiest industrial waterways, home to heavy industry including gas works (i.e., MGPs), coal yards, cement makers, soap makers, tanneries, paint and ink factories, machine shops, chemical plants and oil refineries. In March 2003, GEI completed a Historical Study of the Gowanus Canal for National Grid (owner of the MGP sites along the canal). The study compiled detailed historical information about the Canal and properties within a study corridor of three to eight blocks of the Canal. A history of the Canal and surrounding uplands from this report is provided below:

Prior to the construction of the canal, the Gowanus section of Brooklyn consisted of the creek, ponds and associated wetlands. As part of the initial development of the area in *the mid 1700s, wetlands were drained and the area was developed as farmland. Mills powered by the flow of the Gowanus Creek were also constructed (Brooklyn Historical Society, 2000). In 1848, New York State authorized funds to construct the Gowanus Canal to eliminate the marshland located within South Brooklyn and to open the area to development (New York City Department of City Planning, 1985). The creek was widened and deepened for one and one half miles from the bay to Butler Street (Brooklyn Historical Society, 2000). It was widened to approximately 100 feet and was deepened to approximately 5 feet below the low tide mark throughout the entire length of the canal in order to accommodate barge traffic (Richards, 1848). The banks of the canal were created by driving pilings adjacent to each other and securing them with ribs and caps and were tied into the existing bank (Richards, 1848). Excavated materials from the creek were reportedly used as fill behind the walls of the canal (Richards, 1848). By 1869, the Gowanus Canal was depicted as completed with the current street configuration surrounding the canal. The opening of the canal resulted in the rapid commercial, manufacturing, and industrial development of the area. As early as 1869, areas adjacent to the canal were occupied primarily by lumberyards, coal yards, a concrete plant and stone yards along with other industrial development (Dripps, 1869).*

The continued expansion of commercial and industrial activities was noted along the canal from the late 1800s into the early 1940s. The canal enabled easy transportation and storage of bulk materials such as coal, petroleum, asphalt, and lumber to support the rapid growth of industry in Brooklyn and surrounding areas. The availability of these raw materials and the access to efficient means of transportation, in turn, one spurred the commercial and manufacturing business adjacent to the canal. The canal continued to be a primary route of transportation for goods and materials until the completion of the Gowanus Expressway in 1951 (New York City Department of City Planning, 1985). The construction of the expressway essentially eliminated the need for the canal to be used for transportation purposes; however, its use for manufacturing and storage remained.

The decline of inner-city industry began in the early 1960s and by the mid 1970s more than half of the sites along the Gowanus Canal were reported as unused and in disrepair (Gowanus Canal Community Development Corporation, 2003). In recent years, the canal is rarely utilized for transportation with only the exception of two fuel oil companies and three concrete processing plants which utilize the canal for the delivery of materials.

Today, the land use immediately adjacent to the Canal is comprised of mostly commercial and industrial facilities including concrete plants, warehouses, and parking lots, as well as residential housing. Figure 15 shows the current land use around the Canal. Research indicates that hazardous substances, pollutants and contaminants entered the Canal via several transport pathways, such as direct industrial spills and contaminated groundwater from upland sources. Because of decades of direct and indirect discharges of petroleum products, coal tar, and hazardous substances generated by industrial activity, the Canal became a repository for untreated industrial wastes, and runoff, causing it to become one of New York's most polluted waterways (USEPA, 2010).

At the request of NYSDEC, by publication in the Federal Register on April 8, 2009, USEPA proposed the Canal for inclusion on the NPL established pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605. On March 2, 2010, USEPA placed the Gowanus Canal on the NPL.

Operations at the Former MGP Sites

The three MGPs operated by Brooklyn Union Gas Company along the Gowanus Canal include Fulton Former MGP, Carroll Gardens/Public Place [Former Citizens Gas Works] and Metropolitan Former MGP sites (Figure 16). The MGPs were historically operated to produce gas for former business, industry and the community surrounding the Gowanus Canal from the late 1800s until the early 1960s.

In 2007, a study conducted by GEI on behalf of KeySpan assessed the quality of sediments in the canal. Physical observations of core samples as well as isotopic age dating (NewFields, 2007) have shown that tar-related impacts attributable to the MGP era occur within the accumulated sediments.

The presence of MGP related impacts in the upper sediments is likely related to several processes. These processes include discharge of MGP-related NAPL to the canal, groundwater transport of dissolved constituents through and around the sediment bed, re-distribution as a result of the flushing tunnel operation and tidal action, and disturbance from barge and tug boat traffic (in the middle to lower reaches).

Contaminants from the three former MGP sites appear to have been transported to the Canal via surface runoff (i.e., overland transport of contaminated soils), migration of NAPL through subsurface soils into canal sediments, and groundwater discharge of dissolved-phase contaminants to the canal. The sediment coring effort performed by GEI and USEPA indicates that NAPL contamination is pervasive in native sediments underneath the canal and in soft sediments . The NAPL is thought to be coal tar waste from the three former MGP sites as well as other petroleum related fluids that have migrated through subsurface soils, under or through the bulkheads, and into the more permeable native sediments under the canal. PAHs and benzene, toluene, ethylbenzene, and xylenes(BTEX)are major constituents of coal tar.

Urban Development CSO Discharges in the Canal

The Gowanus Canal watershed includes 1,758 acres, of which 1,524 acres are tributary combined sewer systems in either the Red Hook or Owls Head wastewater treatment plant service areas. The combined sewer system can discharge to the Canal from any of the ten CSO outfall locations in response to storm events, depending on conditions. These locations do not discharge under dry weather conditions. The CSO outfalls, shown in Figure 17, are designated as follows:

Red Hook: RH-031, RH-033, RH-034, RH-035, RH-036, RH-037, RH-038

Owls Head: OH-005, OH-006, OH-007

The current total modeled annual discharge from CSOs is estimated at 377 MG per year. NYCDEP's ongoing strategyis to reduce CSO discharges and improve water quality in the Canal. Although European settlers in 1639 found a productive tidal estuary that they named "Gowanes Creek," they immediately began modifying the Creek and the surrounding wetlands to support tobacco farming and associated navigation and commercial activities. Dam construction, dredging, creating impoundments, wetland filling and draining, and bulkheading drastically changed the waterbody's physical characteristics to very near its present-day configuration by 1869. These physical changes reduced freshwater inflows as well as the watershed's ability to filter pollution from runoff and the waterbody's capacity to flush itself of pollutants due to impaired circulation.

With the population explosion and Industrial Revolution of the mid 1800s came vast amounts of untreated sanitary sewage and wastes from flour mills, cement works, tanneries, and paint, ink and soap factories. Water quality in Gowanus Canal was so poor that the City of Brooklyn convened a team of engineers in the late 1800s to develop solutions to the problem. These solutions included stilling basins to collect solids that would otherwise choke the Canal, the "Big Sewer" completed around 1890 to convey runoff from the streets of Brooklyn to the Canal (and, it was hoped, periodically flush pollutants from the Canal), and the Bond Lorraine Sewer and Gowanus Pump Station (completed in 1908) to convey runoff beyond the Canal and instead discharge to Gowanus Bay. One of the most successful projects was the so-called "Flushing Tunnel," a mile-long, 12-foot diameter tunnel that provided forced circulation in either direction between the head of the Canal and Buttermilk Channel beginning when the project was completed in 1911 until it was damaged in the mid 1960s. Due to lack of funds and anticipation that the completion of the Red Hook wastewater treatment plant would solve water quality problems in the Canal, the repair of the Flushing Tunnel was deferred.

In 1978, the City-Wide 208 Water Quality Study identified Gowanus Canal as requiring additional study to address water quality issues. In April 1982, NYCDEP received a revised 201 Facilities Plan grant to address infrastructure and water-quality issues. Elements of the Plan included upgrading the Gowanus Wastewater Pump Station and force main to the Columbia Street Interceptor, rehabilitation of the Bond Lorraine Sewer and elimination of dry-weather overflows, rehabilitating and reactivating the Flushing Tunnel, monitor and analyze water quality in the Canal and assess dredging of the Canal to a water depth of 13 feet at mean low water. The recommended upgrades to the Gowanus Wastewater Pump station and force main to the Columbia Street Interceptor were completed; however, the force main failed repeatedly and flow was restored to the Bond Lorraine Sewer.

The Inner Harbor CSO Facility Plan, finalized in 1993 and revised in 2003 and 2004, included analyses of the Gowanus Canal drainage area. For Gowanus Canal, the Plan included reactivation of the Gowanus Canal Flushing Tunnel, raising overflow weirs at two relief points to direct CSO toward downstream regulators, and dredging of the Canal to remove accumulated sediments. Construction of the Gowanus Canal Flushing Tunnel began in 1994 and the tunnel was reactivated in March 1999 to provide an estimated flow of 154 million gallons per day (MGD) of water from Buttermilk Channel to the head of the Canal. This work also involved dredging 13,000 cubic yards from targeted areas near the head end to facilitate reactivation of the Flushing Tunnel.

In April 2001, NYCDEP initiated a facility planning project for a Gowanus Facilities Upgrade to address operational issues that developed after implementation of the 201

Facilities Plan and the Inner Harbor CSO Facility Plan. The Gowanus Facilities Upgrade, now underway and scheduled for completion in 2013, involves upgrading the Gowanus Wastewater Pump Station and force main so that it will be able to deliver 30 MGD via a new force main directly to the Columbia Street Interceptor (versus a current design flow rate of 20.2 MGD). Another aspect of the Gowanus Facilities Upgrade is to enhance the Flushing Tunnel pumping system so that the average daily pumping rate increases 40 percent to 215 MGD from 154 MGD using a different pumping design that varies less with tidal elevation (the previous system virtually shut down at low tide) and to provide opportunities for redundancy to improve reliability and substantially reduce or eliminate down time required for maintenance or repairs. The Gowanus Facility Upgrades are expected to be completed by 2014. Once implemented, the upgrade of the Gowanus Wastewater Pump Station is expected to reduce CSOs to the Canal by about 35 percent overall (HydroQual, 2008).

As part of its CSO Long-Term Control Planning Project, NYCDEP finalized a Waterbody/Watershed Facility Plan for Gowanus Canal in August 2008. The associated facility-planning process evaluated a wide array of alternatives to improve water quality in Gowanus Canal. Investigations included field inspections of the outfalls and regulators in the area and confirmed that several CSO outfalls still listed at the time in NYCDEP's State Pollutant Discharge Elimination System (SPDES) permits were no longer operating as CSOs. Those outfalls had previously been designated RH-039 (previously a CSO relief from the Bond Lorraine Sewer at Douglass St. that had been sealed closed), RH-032 (previously a CSO discharging at 9th St. that had been separated and now conveys only stormwater runoff from a small local area), OH-008 (a previous CSO found to be a separated stormwater outfall at East 9th Street), and OH-009 (a previous CSO found to be sealed closed). The Gowanus Canal Waterbody/Watershed Facility Planning work found that that the elements of the Gowanus Facilities Upgrade as described above were cost effective to reduce CSO discharges, and that even 100 percent CSO elimination would not provide significantly greater attainment of water quality standards in the

Canal. Although the Plan recommended that best management practices and green infrastructure be implemented to augment the control actions outlined in the Waterbody/Watershed Facility Plan, the regulatory issues surrounding those types of controls was not well defined at the time and as a result the impact of those controls were conservatively left out of the performance calculations.

Mayor Michael Bloomberg unveiled his PlaNYC initiative in 2007 and worked with the State Department of Environmental Conservation to ensure that the City would pursue green initiatives as part of the overall plan to control CSOs and improve water quality. In September 2010, NYCDEP published the NYC Green Infrastructure Plan and its goals to achieve better water quality and sustainability benefits than the all-Grey Strategy that had been mandated or was currently being implemented by:

- Reducing CSO volume beyond what would be achieved with the all-Grey Strategy alone;
- Capturing the first inch of rainfall runoff from 10 percent of impervious surfaces in CSO areas through green infrastructure and other source controls; and
- Providing substantial, quantifiable sustainability benefits—cooling the city, reducing energy use, increasing property values, and cleaning the air—that the all-Grey Strategy does not provide.

For the Gowanus Canal, implementation of Green Strategies, together with high level sewer separation is anticipated to further decrease CSO discharges to 45 percent of current levels relative to the 35 percent reduction that is expected with only the Grey Strategies already being constructed.

Additional Sources in Upland Areas

The historical development of the Gowanus Canal area was focused on industrial property uses, and as early as 1869, the properties adjacent to the Canal were occupied by lumber yards, coal yards, and stone yards, along with other industrial development (Dripps, 1869). The continued expansion of commercial and industrial activities was noted along the Canal from the late 1800s into the early 1940s. Historical land use in the Canal basin was primarily for heavy industry, including MGPs, coal yards, cement makers, soap makers, tanneries, paint and ink factories, machine shops, chemical plants, oil refineries and storage facilities. Industrial activities have only been subject to governmental environmental regulations for the past few decades. Considering the extensive use of this area by various industries for the past 140 years, there have been relatively few cleanup activities on upland industrial properties under governmental regulatory programs.

Upland sites along the Gowanus Canal that are currently the subject of remedial investigation or are otherwise regulated include:

- the three former MGP sites and over 20 other properties regulated under the New York State Brownfield Cleanup Program (BCP),
- the Voluntary Cleanup Program (VCP),
- the spill program, the Petroleum Bulk Storage (PBS) program,
- the Chemical Bulk Storage (CBS) program, and
- the Major Oil Storage Facility (MOSF) program.

The City has conducted an evaluation of prior land use for numerous upland properties in the vicinity of the Gowanus Canal and selected approximately 100 industrial properties for more detailed evaluation (Comments of the City of New York on the United States Environmental Protection Agency's Draft Monitoring Well Installation Planfor the

Gowanus Canal, April 2010). This review considered numerous factors to evaluate the likelihood of potential ongoing discharge of contaminants to the Canal, and the likelihood of discharge of specific contaminants deemed central to remedial decision-making for Canal sediments. Following this review, the City has recommended further evaluation of 26 high priority industrial properties for further study. While these properties do not represent all potential contaminated sites along the Canal, they were each evaluated by a detailed review of historical Sanborn fire insurance maps to identify features of environmental concern, including evidence of generation, storage (such as tanks), processing, transport or disposal of hazardous waste, hazardous substances, petroleum products, and other wastes. Table 2 identifies the properties and suspected waste types based on the historical map research.

Previous Remedial Investigations in the Canal

This section provides a summary of studies conducted by USEPA and GEI for the CSOs and in the Canal. The description of the studies provided here is limited to the data collection activities described in this work plan.

Ecological Risk Assessment

The data collected for the ecological risk assessment included data to support the Screening Level Ecological Risk Assessment (SLERA) and data to support the Baseline Ecological Risk Assessment (BERA). The data in support of the SLERA included: sediment chemistry from the top 6 inches of sediment at 27 stations for analysis of metals, AVS/SEM, PCB congeners, PCBs, pesticides, SVOCs, and VOC; and, surface water chemistry from 27 stations under different water flow conditions for analysis of dissolved metals, total metals, PCBs, pesticides, SVOCs, and VOCs.

For the BERA EPA supplemented these data with: 12 blue crab samples and 8 small prey fish tissue chemical residues of SVOCs, pesticides, PCB congeners, and total metals; and sediment bioassays using *Leptocheirus plumulosus* and *Nereis virens* at 5 reference stations and 12 site stations. The EPA risk assessment indicated that the *Leptocheirus plumulosus* sediment toxicity testing was confounded by the necessity of three restarts of the test due to problems with organism health. The dates in the laboratory reports for these tests indicate that this problem resulted in an exceedance of EPA recommended holding times for these toxicity tests.

CSO Sampling

For the RI investigation, USEPA sampled the City CSOs in an effort to characterize the CSO discharges to the Canal (USEPA, 2011). Sampling conducted by USEPA consisted of both sediment sampling and water sampling. As part of sediment sampling, USEPA collected sediment samples from seven CSO monitoring locations during dry-weather conditions. For water sampling, CSO effluent samples were collected from ten CSOs for three wet weather conditions. USEPA also collected a single round of samples at the CSO regulators during dry weather, non-discharge conditions. For the water sampling, only discrete grab samples were collected for nine CSOs or CSO regulators for both dry and wet weather conditions. For RH-034, a 24- hour composite sample was collected for dry weather conditions. For wet weather conditions, it seems that USEPA attempted to collect a composite sample, however, it is not clear it the attempt was successful.

Water and sediment samples collected by EPA were analyzed for TCL[1] organics, TAL[2] metals (including mercury and cyanide), and TOC[3]. In addition, the sediment samples

[1] Target Compound List (TCL) as designated by EPA

[2] Target Analyte List (TAL) as designated by EPA

[3] Total organic carbon

from the CSOs were analyzed for grain size. Water samples from CSOs RH-034 and OH-007 were analyzed for alkalinity, ammonia, nitrates, total Kjeldahl nitrogen (TKN), TOC, dissolved organic carbon (DOC), total hardness, silica, sulfates, and TDS. Water samples collected by EPA were analyzed on a whole water basis for TCL organics. TAL metals on solids in CSO were determined by difference, by subtracting the dissolved phase analysis for metals from the whole water metals analysis.

GEI Consultants, on behalf of National Grid, had also conducted a study for the CSOs. The intent of the program was to identify sources of non-CERCLA related contaminants such as pathogens, endocrine disruptor compounds (EDCs), and other pharmaceutical andpersonal care products (PPCPs) to the Canal and to conduct a screening level evaluation ofhuman and ecological pathways and risk from these compounds (GEI, 2011). The sampling program developed by GEI Consultantswas intended to collect CSO water samples at the same time and with the same frequency as the USEPA's CSO sampling program.

Surface Sediment Sampling:

For the RI, USEPA had sampled the top six inches for 27 locations in the Canal. These locations are shown in Figure 19. Surface sediment samples were analyzed for TCL organics, TAL metals (including mercury and cyanide), grain size, TOC, and acid volatile sulfide/simultaneously extracted metals (AVS/SEM). Nineteen surface samples from the canal were also analyzed for polychlorinated biphenyls (PCB) congeners. Sediment samples collected by USEPA were not analyzed for any radiological markers. Additional sample volume was collected by USEPAat each sampling location and archived if future analyses were needed.

In addition, the 10 sediment cores (also shown in Figure 19) collected by USEPA emergency response team the sediment-coring program conducted by USEPA also provided additional information regarding surface sediments by analyzing the top six inches of sediment in each core These cores were analyzed for TCL organics and TAL metals (including mercury and cyanide). Similar to the surface sediment samples, these cores were also not analyzed for radionuclide markers.

Surface Water Sampling

For the RI investigation, USEPA sampled only the surface water in the Canal. Surface water sampling was performed for one dry and one wet weather condition. For the RI, the surface water sampling locations approximately coincided with those of the surface sediment sampling locations. Surface water samples were collected from each location at a depth of 6 inches below the water surface. Surface water samples from all locations were analyzed for TCL organics, TAL metals (total and dissolved, including mercury and cyanide), and total suspended solids (TSS). In addition, during sampling water quality parameters such as salinity, potential hydrogen (pH), specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), temperature, and turbidity were measured by USEPA.

GEI also conducted surface water sampling in the Canal for 138 locations in the Canal. Samples were collected near the water column surface and neat the sediment water column interface. These samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PCBs, pesticides, herbicides, TAL metals, total cyanide, sulfate, biological oxygen demand (BOD), and fecal coliform.

WORK PLAN APPROACH

The main objectives of this work plan proposed by the City include the characterization of the concentrations of COPCs and solids conveyed by the CSOs to the Canal, with a focus on the COPC concentrations on solids themselves. Additionally, this study will increase the understanding of the solids and contaminant mixing in the Canal. Finally, this work plan will also include additional sediment toxicity tests to aid the selection of the preliminary remedial goals to be based on amphipod toxicity tests. Tasks proposed in this work plan include:

- CSO sampling activities during wet weather with some limited sampling during dry weather
- Stormwater Sampling Activities
- Surface sediment collection activities
- Laboratory toxicity testing
- Laboratory chemical analyses
- Data validation
- Data evaluation
- Report Preparation

DATA USE OBJECTIVES

An evaluation of the existing data used in the RI/FS process for Gowanus Canal indicated several data quality and data gap issues that highlighted the lack of a working conceptual site model (CSM). To address these issues and develop a workable CSM, this Work Plan proposes a three phase sampling program.

Phase 1 of the sampling program will be initiated in summer 2012 with the following objectives:

- Sampling of CSOs to:
    - Characterize the COPC concentrations in dissolved and suspended matter in effluent
    - Investigate the impact of NAPL/Fulton MGP Site on CSOs RH-033, RH-037 and RH-038
- Initial surface sediment survey to characterize recent deposition and prepare a preliminary solids balance
- Repeat amphipod toxicity assessment
- Reassess the ecological PRG developed by EPA

Phase 2 of the sampling program will be conducted after Flushing Tunnel upgrades are completed and the Canal reaches a new steady state with the objective to:

- Conduct recently deposited surface sediment and suspended matter surveys
- Develop a solids balance and contaminant mass balance for the new hydrodynamic conditions created by the Flushing Tunnel

Phase 3 of the sampling program will be conducted following Phase 2 data collection with the objective of obtaining data needed to complete a sediment transport model if needed to help understand sediment transport and provide another tool to aid in remedial design.

Data Quality Objectives for Phase 1 Program

The Data Quality Objective (DQO) process is a seven-step iterative planning approach used to design environmental data collection activities. The DQO process helps decision-makers plan the collection of data of the right type, quality, and quantity to support defensible decisions for the investigation and management of hazardous waste sites. Table 4presents the application of the DQO process to the proposed Phase 1 program for addressing the data gaps that have been identified for the Gowanus Canal Superfund Site.

The DQOs focus on the data needs associated with understanding the CSO chemical characteristics and their impact on recently deposited sediments in the canal, understanding the impact of NAPL transport from Fulton MGP site on the CSOs, and reducing the uncertainties in toxicity test results to permit the redevelopment of total PAH PRGs for sediments. This application of the DQO Process is consistent with the United States Environmental Protection Agency (USEPA) guidance document "Guidance on Systematic Planning Using the Data Quality Objectives Process" (USEPA February 2006).

Phase 2 Program

After the completion of the Flushing Tunnel Upgrade project, it is anticipated that the hydrodynamics of the canal will be different from conditions during Phase 1 data collection. Detailed DQOs for this program will be developed following the completion of the Phase 1 sampling and preliminary data evaluation of the Phase 1 data. The overall goal for Phase 2 will be to complete a solids balance, contaminant balance, and COPC fate and transport understanding following the upgrades to the system to update the CSM. The sampling effort for this program will be conducted after the upgrades to the Canal are implemented and will include:

- Surface water sampling in the Canal and reference area under both dry and wet weather conditions
- Additional wet weather CSO sampling
- Sampling of surface sediments in the Canal and Reference areas
- Evaluation of radiological markers such as Be-7 to identify recently deposited materials
- Evaluation of Th-234 and Be-7 to identify harbor *vs.* CSO solids
- Evaluation of COPCs (same as Phase 1 analytical parameters) and TOC, TSS and grain size distribution
- Analysis of CSO tracers, if identified

- Pore water sampling to assess impact due to GW

Phase 3 Program

The City is currently considering the need for completing a sediment transport model for the site. The advantages of developing a sediment transport model include:

- Facilitates greater understanding of measurements
- Closes spatial and temporal gaps in measurements
- Provides a mechanistic causal relationship between sources of solids and contaminants and ambient levels of solids and contaminants
- Has predictive capabilities for projections and future predictions.

The disadvantages are:

- Could delay schedule
- Costs
- Uncertainties
- Iterative process between different models (hydrodynamic, sediment transport, and contaminant transport) to achieve final calibrations can potentially delay final actions.

National Grid has currently developed a hydrodynamic and sediment transport model but the City is yet to review it. The City believes that it will be beneficial to share one modeling framework and avoid dueling models if modeling is determined to be useful to answer questions related to the proposed remedy. Additional issues and data requirements will include:

- Consensus on computational grid resolution and location of open boundary
- Consensus on calibration conditions (usually driven by data availability and representativeness)
- Sufficient data to develop model forcings (meteorology, freshwater, tidal)

- Sufficient data to assess skill of hydrodynamic model (at several locations, time series of water elevation, velocity, temperature, and salinity)
- Sufficient data to define external solids loadings, sediment bed map, solids settling rates, and critical shear stresses.
- Sufficient data to assess skill of sediment transport model (at several locations, times series of TSS and estimates of sediment accumulation rates)
- Ability to "challenge" hydrodynamics and sediment transport calibrations by modeling a contaminant
- Consensus on appropriate predictive uses of the model. What questions will the model attempt to answer? (*e.g.*, cap stability)
- Coordination with EPA to meet EPA requirements (e.g., quality assurance plan, administrative record/docket, ownership/licensing, etc.)

PROJECT PLANNING

The project planning task involves several subtasks that must be conducted to develop the project documents and corresponding schedule necessary to execute the planned studies. One of the major sub tasks involves a site visit to develop field-sampling logistics. The final project plans include this Work Plan, as well as the QAPP (with attached FSP), QMP, and HASP. The latter plans will be submitted separately.

FIELD INVESTIGATION

The field investigation will generate information to fill data gaps in the historical dataset. The data from the proposed studies will be used to address the principal study questions described in Section 3 above. Two phases of field work are planned by the City

- Phase1: Field activities for this phase include sampling of the CSOs during discharge events, collection of recently deposited surface sediments in the Canal and Harbor areas, and sediment sampling required to assess the ecological toxicity for amphipods. The activities for this phase will occur as soon as the planning documents are approved by USEPA.
- Phase 2: Field activities for this phase include surface sediment, water column and CSO sampling to develop an understanding of solids and contaminant mixing. The activities for this phase of the sampling will be conducted after the ongoing upgrades to the flushing tunnel are completed.

For the City's proposed Phase 3, the activities will be focused on sediment transport modeling. Additional field work during this phase is not anticipated at this time. Adjustments to the task planning will be made, if needed, following the completion of each phase and evaluation of the associated data.

Sub Contracting:

Subcontractors will be utilized for performance of specific work activities associated with the Study. Louis Berger & Associates PC (Berger) will coordinate with the NYCDEP to ensure that only responsible and reputable businesses are used to conduct work on the project. Berger strives to identify small businesses (preferably minority and/or woman owned businesses) in an effort to satisfy established small business subcontracting goals.

To support the proposed field activities, the following subcontracts are anticipated:

- A field sampling subcontract to support CSO sampling , surface sediment and water column sampling activities
- A subcontract for field sampling services such as boats.
- A laboratory subcontract for analytical services
- A waste disposal subcontract to remove all wastes (solid and liquid) generated during the investigation

Selection of subcontractors will be achieved utilizing The Louis Berger Group, Procurement Manual: Purchasing and Subcontracting Business Policy and Procedures; and the Delegation of Responsibility and Authority Manual. All acquisitions will utilize greater detailed source selection decision-making criteria. Individual methodology will be based on sound business practices. Certain subcontracts may need to be issued on a sole-source procurement basis due to the proprietary nature of the technology involved or significant previous Site experience; justifications for such subcontracts will be submitted to the Client for review and approval prior to execution.

Mobilization and Demobilization

This subtask will include field personnel orientation, equipment mobilization, marking/staking sampling locations, utility mark-outs (if necessary), and demobilization.

Each field team member will attend an orientation to become familiar with the general operation of the project properties, health and safety requirements, and field procedures.

Equipment mobilization will entail securing all sampling equipment needed for the field investigation. Equipment not available at any of Berger's facilities will be leased, purchased, or if necessary, fabricated. Equipment mobilization may include (but will not be limited to) sampling, health and safety, and decontamination equipment.

Equipment will be decontaminated and demobilized at the completion of all field activities or during the course of the field investigations, as deemed necessary. Personnel, investigation equipment, and large equipment (*e.g.*, sediment sampling equipment) that require decontamination will be decontaminated in the contamination reduction zone identified by the requirements of the HASP. All other sampling equipment will be securely bagged and transported to Berger's equipment facility for decontamination.

CSO Sampling

Effluent samples will be collected from the City CSOs to characterize the COPC and solids concentrations in CSO effluent. Sample collection procedures will be provided in the standard operating procedures (attachment to the QAPP). To characterize the CSOs the sampling will be focused on CSOs RH-034, RH-035, OH-007 and RH-031. These CSOs represent 90% of current CSO discharges to the Canal and will be sampled for at least four wet weather events.

To investigate the impact of Fulton MGP site on the outfalls RH-033, RH-037, and RH-038, at least two wet weather sampling events will be conducted at these outfalls. Additionally, dry weather flow entering the sewage flow regulators associated with the outfalls, R22, R23, R24 and R25 will be sampled for at least three dry weather events. Influent to the small pumping station, which receives the dry weather flow from the Fulton MPG site, will also be sampled for at least three dry weather events. The dry weather samples are intended to identify NAPL or contaminated groundwater entering the CSOs.

The remaining three CSOs, OH-005, RH-031 and RH-038 will be sampled for at least two wet weather events.

To the extent allowable, time composite samples will be collected for each CSO during each event. The sampling duration and technique itself will be developed after consultation with NYCDEP engineers and will be included in the FSP and SOP. Effluent samples will be analyzed for particulate and dissolved phase. Samples will be analyzed for PAHs, total petroleum hydrocarbons (TPHs), PCBs, radionuclide tracers, TAL metals, TOC, TSS, and physical properties.

Stormwater Sampling:

To support the investigation regarding the impact of NAPL/Fulton site on the CSOs storm water sampling will be conducted in the watersheds of CSOs Rh-033, RH-037 and RH-38. Stormwater sampling will be used to establish the background PAH levels in the watershed of these potentially impacted CSOs. Surface water entering the catch basins will be sampled for at least three wet weather events to determine PAH concentrations in storm water runoff in the watershed of these outfalls. Locations of the catch basins will be established after further consultation with NYCDEP engineers and will be included in the FSP. Storm water samples will be analyzed for dissolved and particulate phase. Samples from surface runoff will be analyzed only for TPH, Total PAH, and TSS measurements.

Sediment Grab Sampling for to Reassess Sediment Toxicity – Phase 1 Study

Sediment grab samples will be collected from the Canal to provide the required sediment volume for toxicity tests required to support the reassessment of the ecological PRG developed by USEPA. Sediment toxicity tests for the amphipod (*Leptocheirus* *plumulosus)* the subject species in the EPA's toxicity tests were the basis for the ecological PRG. The testing will be conducted at an off-site, subcontract laboratory using sediment samples collected from Canal and reference areas (Upper New York Harbor and Gowanus Bay). Sediment grabs for toxicity testing and chemical analysis will be obtained from the locations previously sampled and tested as part of the Baseline Ecological Risk Assessment (BERA) for Gowanus Canal (Table 5). These stations include the five previously samples reference stations in Gowanus Bay and the twelve previously sampled stations from Gownaus Canal shown in Figure 20. The collection process will avoid samples that are visibly contaminated with oils or exhibit sheens. If the original locations in the Canal do not yield sufficient oil-free sediment, additional stations may be added as necessary.

Sediment samples will be collected using a Petite Ponar, Ekman or Young-modified Van Veen grab sampler. Sediment toxicity tests are typically conducted with samples representing surface sediments (i.e., the top 6 inches).

The sediment samples will be analyzed for the 17 primary PAHs, grain size distribution, TPH, and TOC. Toxicity will be assessed based on chronic toxicity testing of Leptocheirus plumulosus following EPA methods for testing (EPA, 2011).

Surface Sediment Sampling for Phase 1 Study

Surface (top 0-2 centimeter) sediment samples will be collected from the Canal and background in areas with recent deposition. Samples will be collected from 30 locations distributed along the main stem of the Canal and from 15 locations from the background areas. Preliminary layout of the 30 sample locations in the Canal is shown in Figure 21. Note that the locations shown in Figure 21 are subject to change once additional information such as bathymetry, sediment texture etc. are reviewed.

Sediment samples will be collected using coring tube, a box corer, an Ekman dredge or similar, with the objective of maintaining the integrity of the upper few centimeters of sediment.Samples from all the 45 locations will be initially analyzed for radionuclide beryllium-7 (Be-7) to identify recently deposited material. Up to 30 locations (20 Canal and 10 background) with measurable levels of Be-7 (*i.e.*, recently deposited material) will be analyzed for full suite of contaminants which include TPH, PAHs, PCBs, TOC and TAL metals. These sediments will also be analyzed for grain size distribution, moisture content, bulk density and additional radiological markers such as thorium-234 (Th-234), cesium-137 (Cs-137) and potassium-40 (K-40). Additional radiological markers may be added to the list after further evaluation.

Sampling for Phase 2 Study

The anticipated sampling programs for Phase 2 have been briefly outlined in Section 3 of this work plan. Additional details of this phase of investigation will be supplied at a later date.

SAMPLE ANALYSIS/VALIDATION

All samples collected will be submitted to an Environmental Laboratory Approval Program (ELAP) approved laboratory for analysis in accordance with the following subsections. Subcontracted laboratory analytical services will be validated by Louis Berger data validators or by subcontracted data validation specialists.

Chemical Analysis

Sediment and surface water samples collected for PAHs, TPH, PCBs, radionuclide tracers, TAL metals, TOC, TSS, and sediment properties will be analyzed through the subcontracted laboratory capable of the required analytical sensitivity. The QAPP provides further discussion of required sample analyses and analytical sensitivity and likely laboratory assignments.

Data Validation

Validation will be accomplished by comparing the contents of the data packages and QA/QC results to the requirements contained in the applicable analytical methods and the laboratory Statements of Work. Subcontractor laboratory analytical data will be validated by Louis Berger data validators or a subcontractor in accordance with USEPA's National Functional Guidelines and applicable Region 2 guidelines.

Sample Tracking

All samples will be labeled with individual IDs and included on a chain of custody (COC). The COC will accompany all samples to the laboratory ensuring that all analytical results are appropriately recorded and reported.

DATA EVALUATION

Data evaluations envisioned for the dataset from the Phase 1 study include, but are not limited to, the following:

- Evaluations to establish the COPC concentrations on solids from CSOs
- Evaluation to establish solids loading from CSOs
- Evaluations to establish sources of PAHs in CSOs RH-033, RH-037, and RH-038
- Evaluations to compare contaminant patterns in recently deposited sediments with patterns present in current loads to the Canal from CSOs and background.
- Evaluations to establish solids and chemical mass balance in the Canal
- Evaluations to quantify contributions from various sources especially CSOs

An interim data evaluation report may be prepared for each phase of sampling activity after all validated data are received. The reports will include a written summary, interpretive tables and figures, supporting field sampling logs, and recommendations for adjustments to the design of successive data gathering phases. The interim reports will include summaries of chemical data and other physical observations and field measurements, as well as data evaluations. Evaluation of the data as they are collected will permit early identification of any data gaps and data quality issues that must be resolved prior to completing the Phase 1 study. The interim data evaluation reports will be submitted to USEPA.

PROJECT SCHEDULE

The proposed schedule for the Gowanus Canal Superfund Site Study Tasks will be provided under a separate cover to the USEPA after written authorization to proceed with the field investigation is received.

Quality Assurance

Work on this assignment will be conducted in accordance with the procedures to be defined in the site-specific QAPP and FSP. These documents will be prepared and submitted for review and approval. Field blanks, field replicates, trip blanks, and samples for laboratory spiking will be submitted to the laboratory as outlined in the FSP and QAPP. The desired precision and accuracy of laboratory and field data will be documented in the FSP and QAPP. Laboratory data will be validated in accordance with the USEPA Region 2 validation guidelines.

Deliverables will be reviewed by members of the project team and will include the Project Quality Consultants. The Project Manager (PM) will coordinate these reviews and will promote frequent progress reviews during the project. The comments of the review team will be incorporated into the deliverables before review drafts are submitted to the the USEPA. Louis Berger internal quality control will be performed in accordance with the QMP developed for Gowanus Canal, which will be submitted separately.

Coordination with Other Agencies

RI activities will require coordination among federal, state, and local agencies, as well as coordination with involved private organizations. Coordination activities with these agencies are as described below.

Federal Agencies

The USEPA is responsible for overall direction and approval of all activities for the Site. Sources of technical information may include, but are not limited to, the USEPA, the USACE, the Agency for Toxic Substances and Disease Registry (ATSDR) the USGS, USEPA Laboratories/Edison, and U.S. Department of Interior. These sources may be accessed through the USEPA Regional Project Manager(RPM) for background information on the Site.

State Agencies

The state, through the NYSDEC, may provide review, direction, and input for the RI/FS.

Private Organizations

Private organizations requiring coordination during this Study may include Potentially Responsible Parties (PRPs), concerned residents in the area, and public interest groups such as environmental organizations and the press. Communication with these interested parties will be coordinated through the NYCDEP RPM only; Louis Berger & Associates, PC will neither pursue nor entertain project-specific contact with these private organizations unless expressly directed or permitted to do so by the NYCDEP.

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AMSL	above mean sea level
ATSDR	Agency for Toxic Substances and Disease Registry
AVS/SEM	acid volatile sulfide/simultaneously extracted metals
BCP	Brownfield Cleanup Program
Be-7	beryllium-7
bgs	below grade surface
BOD	biological oxygen demand
BTEX	benzene, toluene, ethylbenzene, and xylenes
CBS	Chemical Bulk Storage
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chain of custody
COPC	concentrations of contaminants of potential concern
CSM	conceptual site model
Cs-137	cesium-137
CSO	combined sewer overflow
DO	dissolved oxygen
DOC	dissolved organic carbon
DQO	Data Quality Objectives
EDC	endocrine disruptor compound
ELAP	Environmental Laboratory Approval Program
FSP	Field Sampling Plan
GEI	GEI Consultants, Inc.

HASP	Health and Safety Plan
JFK	John F. Kennedy
K-40	potassium-40
MG	million gallons
MGD	million gallons per day
MGP	manufactured gas plant
MOSF	Major Oil Storage Facility
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan
NGVD	National Geodetic Vertical Datum
NPL	National Priorities List
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
ORP	oxidation-reduction potential
PAH	Polycyclic Aromatic Hydrocarbons
PBS	Petroleum Bulk Storage
PCB	polychlorinated biphenyls
pH	potential hydrogen
PM	Project Manager
PPCP	pharmaceutical and personal care products
ppm	parts per million
PRG	project remediation goal
PRP	Potentially Responsible Party
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan

QMP	Quality Management Plan
RI/FS	remedial investigation and feasibility report
RPM	Regional Project Manager
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard Operating Procedure
SPDES	State Pollutant Discharge Elimination System
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
TDS	total dissolved solids
Th-234	thorium-234
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VCP	Voluntary Cleanup Program
VOC	Volatile Organic Compound

Table 1: NYC-Area Rainfall Statistics[4]

Rain Gauge Location[1]	Period	Number of Storms Average	Liquid-Equivalent Precipitation (Rainfall) (inch)			Storm Intensity (inch/hour)		Storm Duration (hour)		Delta[2] (hour)	
			Annual Total	Storm Average	Storm COV[3]	Storm Average	Storm COV[3]	Storm Average	Storm COV[3]	Storm Average	Storm COV[3]
JFK Airport	"Standard" 1988	100	40.66	0.41	1.25	0.0677	1.54	6.12	0.9	87.86	0.95
Central Park	1955-2011	116	47.26	0.41	1.57	0.0586	1.36	6.58	1.03	76.39	1.12
LaGuardia Airport	1955-2011	115	43.2	0.37	1.57	0.0571	1.41	6.35	1.02	76.66	1.02
JFK Airport	1970-2011	114	42.52	0.37	1.51	0.0576	1.37	6.22	1.02	77.33	1.01
Newark Airport	1955-2011	118	44.23	0.38	1.59	0.0551	1.41	6.42	1.04	74.92	1.02

Notes:

(1) National Oceanic and Atmospheric Administration Data Center rain gauges. Also referred to as "National Weather Service" rain gauges.

(2) Delta refers to time between storm midpoints.

(3) Coefficient of Variation (standard deviation/average).

(4) Statistics calculated using EPA's SYNOP package with inputs for interevent time of 4 hours and zero minimum rainfall depth

Table 2: Gowanus Canal Discharge Summary for Baseline and With Gowanus Facility Upgrade Conditions[1,2]

	Combined Sewer Outfall Location (shore)	Combined Sewer Outfall Size	Combined Sewer Outfall ID	Baseline Condition Discharge Volume (MG)	Gowanus Facilities Upgrade Discharge Volume (MG)
1	Butler St. (Gowanus PS)	four 163"	RH-034	121	127
2	Bond St. (west)	48"	RH-035	111	3
3	Second Ave. (east)	78"	OH-007	69	69
4	Creamer St. (west)	72"	RH-031	35	11
5	19th St. (east)	36"	OH-006	13	13
6	President St. (east)	18"	RH-036	1.6	1,6
7	Degraw St. (east)	144"x62"H	RH-038	0.9	0.9
8	Carroll St. (east)	42"	OH-005	0.7	0.7
9	Sackett St. (east)	18"	RH-037	0.5	0.5
10	Douglass St. (east)	38"x44"H	RH-033	0.2	0.2
			Total CSO	**354**	**227**

Notes:

(1) Simulated conditions reflect design precipitation record (JFK, 1988) and sanitary flows projected for year 2045 (Red Hook WPCP: 40 MGD, Owls Head WPCP: 115 MGD).

(2) Totals may not sum precisely due to rounding.

(3) Reflects minimum modeled flow of 0.01 MGD per 5-minute interval and minimum 12-hr inter-event time.

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
1	United States of America (Federal ownership and/or operation of facilities) - US Navy - Bethlehem Steel -Sullivan Dry Dock - Todd Shipyards -Ira Bushey & Sons	Multiple	Circa 1915-1955	Shipbuilding & Repair	Metals compounds (including lead, copper, zinc, nickel, chromium, etc.), tri-butyl-tin, PCBs, xylene, toluene, methyl ethyl ketone, methyl isobutyl ketone, ethylbenzene	—	United States of America John C. Cruden US Department of Justice, Environment & Natural Resources Division 601 D St. NW Washington, DC 20004
2	Ira Bushey & Sons	722-764 Court St.	Circa 1915-present	Shipbuilding & Repair / Bulk Petroleum Terminal	Metals compounds (including lead, copper, zinc, nickel, chromium, etc.), tri-butyl-tin, PCBs, xylene, toluene, methyl ethyl ketone, methyl isobutyl ketone, ethylbenzene	Ira S. Bushey & Sons •1913 – Incorporated in the State of New York •1977 – Acquired by Amerada Hess Corporation •2006 – name changed to Hess Corporation	Hess Corporation Timothy B. Goodell Senior Vice President and General Counsel 1185 Avenue of the AmericasNew York, NY 10036
3	American Can	3rd Street/3rd Ave (383-361 3rd Ave., 232-250 3rd St.)	Circa 1906-1945	Can and tin ware manufacturing	Metal compounds (tin, copper, lead, zinc, etc.), cresol, PAHs, sulfuric and other acids, phenol, xylene, and various chlorinated solvents	American Can •1986 – American Can Company and National Can Company merge •1986 – Triangle Industries acquired National Can Company •1988 – Pichiney S.A. acquired Triangle Industries •2003 – Alcan acquired Pichiney S.A. •2007 – Rio Tinto merged with Alcan	Rio Tinto Alcan L. Yves Fortier Chairman 1188 Sherbrooke Street WestMontreal, Quebec H3A 3G2 Canada Rio Tinto Alcan Richard B. Evans President and CEO 1188 Sherbrooke Street WestMontreal, Quebec H3A 3G2 Canada
4	Burns Brothers	3rd/Bond Sackett & Bond	Circa 1910-1970	Coal yard	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	Burns Brothers •1954 – acquired by Glen Alden •1972 – merged with Rapid American Corporation	Rapid American Corporation Meshulam Riklis, President 100 Pine St Harrisburg, PA 17101-1200
5	Greason Son & Dazell, Inc.	3rd/Gowanus Canal	Circa 1900-1970	Coal yard	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	Greason Son & Dazell, Inc. •1938 – acquired by The Pittston Company •2003 – name changed to Brink's, Inc. (a.k.a The Brink's Company)	The Brink's Company Michael T. Dan, CEO 1801 Bayberry Court Richmond, VA 23226-8100
6	Koppers Company, Inc.	300-326 Nevins St.	Circa 1915-1970	Coal, coke, garages	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	Koppers Company, Inc. •1912 – H. Koppers Company incorporated •1944 – Reorganized from 100 subsidiaries into a single corporate unit called Koppers Company, Inc. •1988 – Beazer Materials acquired Koppers Company, Inc. Beazer sold some of the assets including the Koppers name to a management-led group to form Koppers Industries, Inc. •2009 – Koppers Industries, Inc. is active	Koppers Industries, Inc. Steven R. Lacy Senior Vice President, Administration, General Counsel, and Secretary 436 Seventh Avenue Pittsburgh, PA 15219

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
7	New York Tarter Standard Brands	59 9th St. (36-61 9th St.)	Circa 1905-1940	Chemical works	Metal compounds, including zinc, copper, nickel, lead, chromium, arsenic, cadmium, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, dimethyl phthalate, phenol, chloroform, and various acids	New York Tarter Company •1929 – Fleischmann Company absorbed several smaller companies, including New York Tarter Company and formed the Standard Brands, Inc. •1981 – Standard Brands, Inc. merged with Nabisco to for Nabisco Brands, Inc. •1985 – R.J. Reynolds bought Nabisco and formed RJR Nabisco •1988 – Kohlberg Kravis Roberts acquired RJR Nabisco •2000 – Phillip Morris Companies (Altria Group) acquired Nabisco and merged it with Kraft Foods •2007 – Kraft Foods and Nabisco, as a Kraft subsidiary, spun off from Altria Group	Kraft Foods, Inc. Marc S. Firestone Executive Vice President, Corporate and Legal Affairs and General Counsel, Three Lakes Drive Northfield, Illinois, 60093
8	Pure Oil	North of 1st St. (87-107 1st St. and 388-402 Carroll St.)	Circa 1890-1950	Petroleum related	Benzene, toluene, xylene, phenol, methyl isobutyl ketone, zinc and lead compounds	Pure Oil •1897 – Registered with NYS Department of State •1917 – Ohio Cities Gas Company acquires Pure Oil Company •1920 – Ohio Cities Gas Company changes name to Pure Oil Company •1965 – Union Oil Company of California (Unocal) acquired Pure Oil Company •2005 – Chevron Corporation acquired Unocal	Chevron Corporation Charles A. James Vice President and General Counsel 6001 Bollinger Canyon RoadSan Ramon, CA 94583-2324
9	Standard Oil of New Jersey	South of 1st St. (64-106 1st St.)	Circa 1890-1950	Petroleum terminal operations	Benzene, toluene, xylene, phenol, methyl isobutyl ketone, zinc and lead compounds	Standard Oil of New Jersey •1892 – Stockholders form Standard Oil Trust •1911 – Standard Oil Trust broken up into independent companies; Standard Oil of New York formed •1931 – name changed to Socony-Vacuum Corporation •1934 – name changed to Socony-Vacuum Oil Company, Inc. •1955 – name changed to Socony-Mobil Oil Company •1966 – name changed to Mobil Oil Corporation •1976 – name changed to Mobil Corporation •1998 – name changed to ExxonMobil Corporation	ExxonMobil C.W. Matthews Vice President and General Counsel 5959 Las Colinas Boulevard Irving, TX 75039-2298

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
10	Stauffer Chemical	9th/Gowanus Canal (36-69 9th St.)	Circa 1940-1970	Chemical works	Metal compounds, including zinc, copper, nickel, lead, chromium, arsenic, cadmium, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, dimethyl phthalate, phenol, chloroform, and various acids	Stauffer Chemical •1895 – Incorporated •1913 – registered in New York. •1985 – acquired by Chesebrough-Pond's, Inc. •1986 – Acquired by Unilever •1987 – Unilever sold Stauffer's agrichemical business to Imperial Chemical Industries, PLC •On January 2, 2008, AkzoNobel completed the acquisition of Imperial Chemical Industries PLC (ICI), following an initial announcement in August 2007.	Francis X. Sherman, CEO AkzoNobel 525 West Van Buren Street Chicago, Illinois, 60607-3823
11	Barrett Company Allied Chemical & Dye (Warren Chemical)	Halleck/Smith Btwn Sigourney & Helleck (541-627 Court St., 170-192 Sigourney, 189-213 Halleck, and 627-641 Smith)	Circa 1890-1955	Manufacture of coal tar products	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	Barrett Company (Warren Chemical Company, Barrett Manufacturing •1920 – Allied Chemical & Dye Corporation formed from the amalgamation of five American chemical companies •1958 – changed name to Allied Chemical Corporation •1981 – changed name to Allied Corporation •1985 – merged with the Signal Companies and changed name to Allied-Signal, Inc. •1993 – changed name to Allied Signal •1999 – Allied Signal merged with Honeywell International, Inc.	Honeywell International, Inc. Peter M. Kreindler Senior Vice President an General Counsel 101 Columbia Road Morris Township, New Jersey,07962
12	Texaco	740-766 Clinton	Circa 1915-1960	Petroleum terminal operations	Benzene, toluene, xylene, phenol, methyl isobutyl ketone, zinc and lead compounds	Texaco •1901 – The Texas Company formed •1959 – changed name to Texaco, Inc. •2001 – merged with Chevron and formed ChevronTexaco	ChevronTexaco Charles A. James Vice President and General Counsel 6001 Bollinger Canyon Road San Ramon, CA 94583-2324
13	Debevoise Company, Subsidiary of Seagrave Corporation	74 20th St.	Circa 1935 to 1988	Paint manufacturing facility	Metals including zinc, copper, lead, chromium, cadmium, and cobalt compounds. PCBs, xylene, methyl ethyl ketone, naphthalene, benzene, dimethyl phthalate, and phenol	Debevoise Company •1910 – Debevoise Company formed •Sometime Circa 1965, it became a subsidiary of Seagrave Corporation •1965 – name changed to Seagrave Delaware Corporation •1965 – name changed to Seagrave Corporation •1980 – name changed to Vista Resources, Inc. •1995 – name changed to Fuqua Enterprises, Inc.	J.B. Fuqua Fuqua Enterprises, Inc. 1201 W Peachtree St NW Suite 5000 Atlanta, GA 30309-3467

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
14	Bayside Fuel Oil Corporation	510 Sackett St. 537 Smith St.	Circa 1970 to present	Petroleum terminal	Benzene, toluene, xylene, phenol, methyl isobutyl ketone, zinc and lead compounds	Bayside Fuel Oil Corporation •1937 – predecessor that eventually becomes Bayside Coal & Fuel Company began operations •1943 – Bayside Coal & Fuel Oil Company Inc incorporated •1952 – name changed to Bayside Fuel Oil Corporation •1965 – incorporated as Bayside Fuel Oil Depot Corporation	Bayside Fuel Oil Depot Corporation Chairman or CEO 1776 Shore Parkway Brooklyn, NY 11214
15	Cirillo Brothers	Centre/Smith	Circa 1940-1970	Fuel oil and coal storage	Benzene, toluene, xylene, phenol, methyl isobutyl ketone, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	Cirillo Brothers •1944 – incorporated •1976 – changed name to Cibro Petroleum/Brooklyn, Inc.	Cibro Petroleum/Brooklyn, Inc. 1327 – 38th Street Brooklyn, NY 11218
16	Metropolitan Petroleum	South side of 6th St. Basin	Circa 1970-1990	Petroleum terminal	Benzene, toluene, xylene, phenol, methyl isobutyl ketone, zinc and lead compounds	Metropolitan Petroleum Company •1965 – Pittston Chemicals, Inc. •1980 – changed name to Pittston Petroleum, Inc. •1980 – changed name to Metropolitan Petroleum, Inc. •1989 – merged with Atlantic Fuels Marketing Corporation •1989 – sold to Castle Coal & Oil Company •1989 – name changed to Castle Oil Corporation	Castle Oil Corporation Michael M. Meadvin Senior Vice President, GeneralCounsel, Corporate Secretary 500 Mamaroneck Avenue Harrison, NY 10528
17	American Agriculture Chemical Company	Huntington/Smith	Circa 1890-1915	Chemical fertilizer manufacturer	Metals including zinc, copper, lead, manganese, nickel, chromium, cadmium, and cobalt compounds. Nitrate coumpounds, ethylene glycol, methyl isobutyl ketone, methanol, formaldehyde, acids	American Agriculture Chemical Company •1963 – acquired by Continental Oil Company •1963 – name changed to Conoco, Inc. •1981 – Conoco acquired by E.I. DuPont DeNemours Company	E.I. DuPont De Nemours and Company Thomas L. Sager Senior Vice President and General Counsel 1007 Market Street Wilmington, DE 19898
18	American Nickel Alloy Manufacturing Company	1st St. Basin	Circa 1935-1945	Nickel alloy manufacturing	Metals including nickel, zinc, lead, and copper. Various chlorinated and organic solvents	American Nickel Alloy Manufacturing Company •1933 – Anglo-American Metals & Ferro Alloy Corporation formed •1941 – name changed to American Nickel Alloy Manufacturing Company •1988 – name changed to Algrun Metals & Minerals Corporation	Algrun Metals & Minerals Corporation Ruth G. Sondheimer, CEO 30 Vesey Street New York, NY 10007
19	Doehler Die Casting	9th and Huntington Street near Court Street	1922-1933	Die casting and manufacture	Zinc, chromium, lead, copper, manganese, methanol, PAHs, sulfuric and other acids, phenol, xylene, and various chlorinated solvents	Doehler Die Casting •1946 – merged with Jarvis Body Manufacturing and formed Doehler Jarvis Company •1953 – National Lead acquired Doehler Jarvis •1971 –changed name to NL Industries, Inc.	NL Industries, Inc. Robert Graham Vice President and General Counsel 5430 LBJ Freeway Suite 1700 Dallas, TX 75240-2697

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
20	Atlantic Oil Works/American Oil Company	381 Smith St.	Circa 1890-1915	Oil and coal storage and handling	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	American Oil Company •1961 – acquired by Amoco Corporation •1998 – Amoco merged with BP PLC	BP America R.A. Malone, ECO 4101 Windfield Rd. Warrenville, IL 60555
21	State of New York	Foot of Henry St.	Circa 1920-present	Barge terminal	Heavy metals, waste paints, solvents, resins, VOCs, and cyanide	---	State of New York Andrew M. Cuomo Office of the Attorney General The Capitol Albany, NY 12224
22	City of New York	Multiple	1850-present	Incinerator, dump, flushing canal, transit yard and asphalt plant.	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	—	City of New York Michael A. Cardozo Corporation Counsel 100 Church Street New York, NY 10007
23	Brooklyn Union Gas	Multiple	Circa 1870-1955	Gas works and storage	Coal tar	—	National Grid
24	Woolsey Marine Industries, Inc.	183 Lorraine St.	1982-1987	Paint manufacturer	Metals including zinc, copper, lead, chromium, cadmium, and cobalt compounds. PCBs, xylene, methyl ethyl ketone, naphthalene, benzene, dimethyl phthalate, and phenol	Woolsey Marine Industries, Inc. • 2009 – active	Woolsey Marine Industries, Inc.C/O Olvany, Eisner, & Donnelly645 Madison Ave. New York, New York, 10022
25	Ferrara Brothers Building Materials Corporation	435 Hoyt St.	Early 1970s-1999	Cement manufacturing facility; Shipping/receipt of cargo	Lime, silica sand, alumina, iron, gypsum, dissolved solids, waste oil, and constituents from machinery and equipment maintenance such as xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	Ferrara Brothers Building Materials Corporation •1969 – initial filing with NY SOS • 2009 – active	Ferrara Brothers Building Materials Corporation Joseph A. Ferrara President 120-05 31st Avenue Flushing, NY 11354
26	Hochberg Brothers & Schwartz Inc. (aka Hochberg Brothers & Schan, Inc.)	386 Third Ave.	1969-1996	Store fixture manufacturing, including, welding, woodworking, and painting	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	Hochberg Brothers & Schan, Inc. •1971 – initial filing with NY SOS •1991 – merged into HBSA Industries, Inc. • 2009 – active	HBSA Industries, Inc. C/O The Prentice-Hall Corporation System, Inc. 15 Columbus Circle New York, New York, 10023-7773
27	ABC Collision Corporation	549 Sackett St 270 4th Ave.	1992-1998 (at 270 4th Ave. to present)	Auto repair	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	ABC Collision Corporation •1999 – initial filing with NY SOS • 2009 – active	ABC Collision Corporation Anthony Dimonda 270 4th Avenue Brooklyn, New York, 11215
28	Abigail Press, Inc.	3rd Street, 4th Street, Hoyt Street	1991-1996	Printer (i.e., operates printing presses)	Metals including zinc, copper, lead, and chromium compounds. PCBs, xylene, methyl ethyl ketone, naphthalene, benzene, and phenol	Initial filing with NY SOS in 1956 • 2009 – active	Abigail Press, Inc. Salvatore Stratis 97-35 133rd Ave Ozone Park, New York, 11417

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
29	Adel Rootstein (USA), Inc.	145 18th St.	1991-present	Manufacturer of fiberglass mannequins	Methanol, ethylene glycol, vinyl acetate, and various chlorinated solvents	Adel Rootstein (USA), Inc. •1970 – initial filing with NY SOS • 2009 – active	Adel Rootstein (USA), Inc. Frank Patton Jr. 420 Lexington Ave New York, New York, 10170 Adel Rootstein (USA), Inc. Junichiro Morita, CEO 205 West 19th St. New York, New York, 10011
30	Antarenni Industries, Inc.	Smith & Huntington Sts.	1971-1980	Wrought iron, chrome dinette sets	Metal compounds, including zinc, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	Antarenni Wrought Iron Manufacturing Corporation •1960 – initial filing with NY SOS •1969 – name changed to Antarenni Industries, Inc. • 2009 – active	Antarenni Industries, Inc. 76 Rochester Ave. Brooklyn, New York, 11233
31	Bruno Truck Sales	435 Hamilton Ave.	1977-present	Automobile/truck service	Metal compounds, including zinc, and lead. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	Bruno GMC Truck Sales Corporation •1963 – initial filing with NY SOS •1994 – name changed to Bruno Real Property Inc. •1994 – name changed Bruno GMC Truck Sales Corporation • 2009 – active	Bruno GMC Truck Sales Corporation C/O Arnold Simon, Esq. 45 Executive Drive, Suite 220 Plainview, New York, 11803 Adrienne Milea, CEO Bruno GMC Truck Sales Corporation 435 Hamilton Avenue Brooklyn, New York, 11232
32	Cameo Metal Products, Inc.	127 12th St.	1993-present	Metal manufacturing	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, dimethyl phthalate, phenol, and various solvents	Cameo Metal Products, Inc. •1971 – initial filing with NY SOS • 2009 – active	Cameo Metal Products, Inc. Vito Dimaio, CEO 127 12th Street Brooklyn, New York, 11215
33	Chuck Gurdin, Inc.	479 Degraw St.	1964-1988	Stainless steel tanks, pressure vessels manufacturing	Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	Chuck Gurdin, Inc. •1964 – initial filing with NY SOS • 2009 – active	Chuck Gurdin, Inc. Neil Gurdin, CEO 430 West Merrick Road #21 Valley Stream, New York, 11580
34	Compounding Corporation of America	251 Butler St.	1969-1982	Compounding plastics	Hydrocarbons, isobutene, hexane, styrene, ehtylbenzene, methanol, ethylene glycol, nitrate compounds, etc.	Chemical Compounding Corporation •1929 – initial filing with NY SOS •1988 – name changed to Truetech, Inc. •2009 – active	Truetech, Inc. Daniel N. Kohn 680 Elton Ave. Riverhead, New York, 11901
35	Crompton Corporation	688-700 Court St	1999-2002	Chemical manufacturing, dye and pigment manufacturing	Heavy metals including chrome, cadmium, barium, PCBs methanol, phenol, mineral spirits, etc.	Crompton Corporation •1999 – initial filing with NY SOS as CK Witco Corporation •2000 – name changed to Crompton Corporation •2005 – name changed to Chemtura Corporation •2009 – filed for bankruptcy; claim date not yet set	Chemtura Corporation Craig A. Rogerson, CEO 199 Benson Road Middlebury, Connecticut, 06749
36	Lewis Machine Corporation	215 Butler St.	1986-present	Machine Shop (mechanical counters; can, case, bottle; distance measuring wheels)	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	Lewis Machine Corporation •1987 – initial filing with NY SOS • 2009 – active	Lewis Machine Corporation Eugene Wayda, CEO 215 Butler Street Brooklyn, New York, 11217

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
37	OZ/Gedney Company, Inc.	262-270 Bond St.	1969-1996	Manufacturer of electrical fittings and enclosures	Metal compounds, including zinc, copper, nickel, lead, etc., chlorinated solvents and sludge	Gedney Electric Company, Inc. •1960 – initial filing with NY SOS •1978 – name changed to O.Z. Gedney Company •1978 – name changed to OZ/Gedney Company, Inc. • 2009 – active	O-Z/Gedney Company, Inc. C/O C T Corporation System 111 Eighth Avenue New York, New York, 10011
38	International Salt Company, Inc.	250 feet above Hamilton Ave	1950-1965	Receipt of cargo, machine and equipment maintenance	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	International Salt Company, Inc. •1940 – initial filing with NY SOS •1989 – name changed to Akzo Salt, Inc. •1994 – name changed to Akzo Nobel Salt, Inc. • 2009 – active	AKZO Nobel Salt Inc. Philip E Radtke, CEO 525 W Vanburen St Chicago, Illinois, 60607-3835
39	Brooklyn Rapid Transit Company	3rd Street, 3rd Avenue, 1st Street Basin	1904-1929	Power House	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, lead, mercury, copper, and PAHs	New York, Brooklyn, and Jersey City Rapid Transit Company •1900 – initial filing with NY SOS • 2009 – active	George Milsou New York, Brooklyn, And Jersey City Rapid Transit Company 55 Liberty St. New York, New York, 10005
40	John P. Carlson, Inc.	Carroll Street, Gowanus Canal	1938-1950	Printing ink manufacturer	Metals including zinc, copper, lead, chromium, cadmium, and cobalt compounds. PCBs, xylene, methyl ethyl ketone, naphthalene, benzene, dimethyl phthalate, and phenol	John P. Carlson, Inc. •1921 – initial filing with NY SOS •1973 – name changed to Chromadyne Corporation • 2009 – active	Chromadyne Corporation Lewis Roberts 72 Union St. Newark, New Jersey, 07105
41	International Terminal Operating Company, Inc.	Foot of 17th to 22nd Streets extended	1965-1978	Receipt of cargo, maintenance of equipment and machinery	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, dimethyl phthalate, phenol, and various solvents	International Terminal Operating Company, Inc. •1954 – initial filing with NY SOS •2001 – name changed to P&O Ports North America, Inc. •2007 – name changed to Ports America, Inc. • 2009 – active	Ports America, Inc. Stephen Edwards, CEO 99 Wood Avenue South 8th Fl Iselin, New Jersey, 08830-2713
42	Hauck Manufacturing Company	10th Street, 2nd Avenue	1938-1950	Oil burner manufacturer	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, naphthalene, benzene, phenol, and various solvents	Hauck Manufacturing Company •1907 – initial filing with NY SOS • 2009 – active	Hauck Manufacturing CompanyHerbert Hoffman 2 W Liberty Blvd., Ste 120 Malvern, Pennsylvania, 19355
43	Greco Brothers Ready Mix Concrete Company, Inc.	381 Hamilton Ave.	1977-1999	Cement manufacturer	Lime, silica sand, alumina, iron, gypsum, dissolved solids, waste oil, and constituents from machinery and equipment maintenance such as xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	Greco Brothers Mason Contracting Company •1958 – initial filing with NY SOS •1967 – name changed to Greco Brothers Ready Mix Concrete Company, Inc. • 2009 – active	Greco Brothers Ready Mix Concrete Company, Inc. Joseph C. Greco Jr., President 87-13 Rockaway Boulevard Ozone Park, NY 11416

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History**	Agent of Service
44	Spentonbush Fuel Transport Service, Inc.	671 Court St.	1988-1999	Bulk petroleum terminal	Benzene, toluene, xylene, phenol, methyl isobutyl ketone, zinc and lead compounds	Spentonbush Fuel Transport Service, Inc. •1925 – initial filing with NY SOS •1965 – name changed to Spentonbush Transport Service, Inc. •1991 – name changed to Spentonbush Star Companies, Inc. • 2009 – active	Spentonbush Star Companies, Inc. J.B. Hess 1185 Avenue of Americas New York, New York, 10036
45	Continental Terminals, Inc.	Below Hamilton Avenue Bridge, East side of Henry Street Basin	1965-1999	Receipt of cargo, maintenance of equipment and machinery	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, naphthalene, benzene, phenol, and various solvents	Continental Terminals, Inc. •1958 – initial filing with NY SOS • 2009 – active	Continental Terminals, Inc. Douglas Martocci, Chairman 54A Hackensack Avenue Kearny, NJ 07032
46	15th Street Auto Body, Inc.	28 15th St.	Circa 1971 to the present	Auto painting and repair	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	•2009 – Active	Joseph R. Amato, CEO 15th Street Auto Body, Inc. 28 15th Street Brooklyn, NY 11215 15th Street Auto Body, Inc. C/O David M. Kreitzer, Esq. 275 Madison Ave. New York, NY 10016
47	Sammy's Auto Repair	44 15th St.	1986 to the present	Auto painting and repair	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	• 2009 – Active	Hussein Hamoush, CEO Sammy's Auto Repair 44 15th St. Brooklyn, NY 11215
48	Brooklyn Improvement Company	Multiple	Circa 1920-1955	Owner/Lessor to metal products manufacturers, fuel companies, coal and coke yards, sawmill, and ash removal dumping platform	Metal compounds, including zinc, copper, nickel, lead, chromium, arsenic, cadmium, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, PAHs	•2009 – Active	The Brooklyn Improvement Company P.O. Box 2700 New York, NY, 10163
49	Curtis Blue Printing Corporation.	147 7th St.	Circa 1993 to the present	Commercial Printing, lithographic	Metals including zinc, copper, lead, and chromium compounds. PCBs, xylene, methyl ethyl ketone, naphthalene, benzene, and phenol	• 2009 – Active	Israel Gluck, CEO Curtis Blue Printing Corporation 133 Imlay Street Brooklyn, NY 11231-1222
50	J. Curtis Blue, Inc.	147 7th St.	Circa 1993 to the present	Commercial Printing, lithographic	Metals including zinc, copper, lead, and chromium compounds. PCBs, xylene, methyl ethyl ketone, naphthalene, benzene, and phenol	•2009 - Active	Salvatore F. Terillo, CEO J. Curtis Blue Inc. 147 7th Street Brooklyn, NY 11215

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#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
51	Custom Fixtures Inc.	129 13th St.	Circa 1986 to the present	Metal finishing manufacturers	Zinc and copper compounds, nickel, chromium, and various solvents	• 2009 – Active	Joseph Waknine, CEO Custom Fixtures Inc. 129 13th Street Brooklyn, NY 11215 Custom Fixtures, Inc. 736 Allerton Ave., Suite 207Bronx, NY 10467
52	D.V.S. Iron & Aluminum Works, Inc.	117 14th St.	Circa 1969 to present	Metal goods manufacturer	Metal compounds, including zinc, copper, nickel, lead, etc. and various solvents	• 2009 – Active	Louis Dijanic, CEO D.V.S. Iron & Aluminum Works,Inc. 117 14th St. Brooklyn, NY, 11215
53	Dents Out Towing and Collision	47 15th St. 327 Bond St. 578 3rd Ave.	Circa 1989 to the present	Auto repair	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	•2009 – Active	Mark Eusano, CEO Dents Out Towing & Collision 47 15th Street Brooklyn, NY 11215
54	General Elevator Company	223 Nevins St.	Circa 1971 to circa 1980	Elevator manufacturing and repair	Metal compounds and various solvents	•1999 – Merged into Thyssen Elevator Company •1999 – Thyssen Elevator Company merged with Krupp to form ThyssenKrupp Elevator Corporation •2009 – Active	W Barry Pletch, CEO ThyssenKrupp Elevator Corporation 2500 Northwinds Pkwy Ste 375 Alpharetta, GA, 30004
55	Hamilton Auto Body and Repair Corporation	191 Centre St.	1997 to present	Auto repair and stereo installations	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	•2009 – Active	Khaled Saleh, CEO Hamilton Auto Body and RepairCorporation 191 Centre St Brooklyn, NY 11231
56	Superior Tinsmith Supply Company, Inc.	282 6th St.	Circa 1971 to the present	Sheet metal fabricators	Metal compounds (e.g., zinc, copper, nickel, lead, etc), xylene, methyl ethyl ketone, benzene, and various solvents	•2009 – Active	Robert Grosseto, Ceo Superior Tinsmith Supply Company, Inc. 282 Sixth Street Brooklyn, NY, 11215
57	Ulano Corporation	280 Bergen St. 255 Butler St. 110 Third Ave.	Circa 1988 to present	Manufacturer of screen making products	PCBs, xylene, methyl ethyl ketone, naphthalene, benzene, and phenol	•2009 - Active	David R. Eisenbeiss, CEO Ulano Corporation 110 Third Avenue Brooklyn, NY 11217 David R. Eisenbeiss, CEO Ulano Corporation 1929 Marvin Circle Seabrook, TX, 77586
58	IESI NY Corporation	577 Court St.	Circa 1989 to the present	Waste transfer station / Recycling	Metals (e.g., mercury, chromium, lead, arsenic, cadmium), paints and pigments, rubber, grease and oil, VOCs	• 2009 – Active	IESI NY Corporation C/O CT Corporation System 111 Eighth Avenue New York, NY 1011
59	Waste Management of New York, LLC	577 Court St.	Circa 1989 to the present	Waste transfer station / Recycling	Metals (e.g., mercury, chromium, lead, arsenic, cadmium), paints and pigments, rubber, grease and oil, VOCs	• 2009 – Active	Waste Management of New York, LLC C/O CT Corporation System 111 Eighth Avenue New York, NY 1011 Parent company Rick L. Wittenbraker, GeneralCounsel Waste Management, Inc. 1001 Fannin, Suite 4000 Houston, TX 77002

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
60	Waterfront Disposal Corporation	110 5th St.	Circa 1997 to the present	Demolition contractors	Various metal compounds (e.g., arsenic and copper), xylene, ammonia, various solvents, paints and pigments, grease and oil, VOCs	• 2009 – Active	Margaret Giouzelis, CEO Waterfront Disposal Corporation 110 5th Street Brooklyn, NY 11215
61	Leo Prager, Inc.	55 9th St.	Circa 1971 to the present	Manufacturer of metal partitions and fixtures.	Metal compounds, including zinc, copper, nickel, lead, etc. and various solvents	•1947 – Initial filing •2009 – Active	Peter Schoenfeld, CEO Leo Prager, Inc. 138 West 25th Street New York, NY 10001-7405
62	Masters Auto Body, Inc.	511 3rd Ave.	Circa 1986 to the present	Auto painting and repair	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	• 2009 – Active	Hector Yulfo, CEO Masters Auto Body, Inc. 511 3rd Ave. Brooklyn, NY 11215
63	Merit Oil of New York, Inc.	204-222 4th Ave	Circa 1978 to at least 1996	Gas station and repair	Metal compounds, including zinc and lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, phenol, and various solvents	Merit Oil of New York, Inc. •1972 – Initial filing as Save Way Times •1979 – Name changed to Merit Oil Company of New York, Inc.	Merit Oil of New York, Inc. C/O CT Corporation System 111 Eighth Avenue New York, NY 1011 Ivan Gabel, CEO Merit Oil of New York, Inc. 551 W. Lancaster Ave. Haverford, PA 19041
64	New Resina Corporation	265 Creamer St.	1997- at least 2001	Manufacturer of machinery and equipment	Solvents, naphtha and related constituents	•1994 – Initial filing •2003 – Resina West acquired the New Resina Corporation. • 2009 – Active	New Resina Corporation C/O Koerner Silberberg & Weiner Attn: Carl Seldin Koerner Esq33 Irving Place New York, NY, 10003 Lonnie Belts, President Resina West 41542 Cherry Street Murrieta, CA 92562
65	O.C. Adhesives Corporation	76 4th St.	Circa 1971 to circa 1984	Adhesives manufacturer	Acetone, heptane, hexane, methyl ethyl ketone, methylene chloride, PCBs, VOCs	•1962 – Initial filing •2009 – Active	Stanley Myers, President O.C. Adhesives 30 W. 60th Street New York, NY 10023
66	Scranton & Lehigh Coal Co., Inc.	242 Nevins 223 Nevins/259 Butler	Circa 1915 to 1950s	Coal handling	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	•1906 -incorporated •1971 Changed Name to Patterson Fuel Oil Company, Inc. •2009 – active	Stephen J. Patterson, III (CEO)Patterson Fuel Oil Company, Inc. 185 Magnolia Ave. Floral Park, NY 11002
67	Metal Package Corp.	346 Carroll Street	Circa 1920s to 1940s	Metal fabrication	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, dimethyl phthalate, phenol, and various solvents	•1929 – Incorporated •1935 – changed name to National Can Company •1937 – changed name to McKeesport Tin Plate Corporation •1941 – changed name to National Can Corporation •1987 – changed name to American National Can Company •2000 – changed name to Rexam Beverage Can Company •2009 – active	Harry Barto, CEO Rexam Beverage Can Company 8770 W. Bryn Mawr Chicago, IL 60631 Executive Office Rexam Beverage Can Company 4201 Congress Street, Suite 340 Charlotte, NC 28209

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
68	Dale Coal & Coke Corp. (Dale Lehigh Coal Co., Inc.)	38 2nd Avenue	Circa 1934 to 1940s	Coal handling	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	•1934 – incorporated •2009 – active	Dale Lehigh Coal Co., Inc. 353 Fifth Ave. New York, NY 10016
69	Commonwealth Fuel Co.	497 Union Street	1920 to circa 1929	Coal handling	Benzene, methyl chloroform, ethylene dichloride, methylene chloride, methanol, creosote, lead, mercury, copper, and PAHs	•1920 Incorporated •1927 merged to form the Rubel Coal and Ice Corporation •1929 Acquired by Burns Brothers •1954 – Burns Brothers acquired by Glen Alden •1972 – merged with Rapid American Corporation	Rapid American Corporation Meshulam Riklis, President 100 Pine St Harrisburg, PA 17101-1200
70	Electric Switchboard Co. Inc.** (ICS#; P-26019; NYC ID#: 14626)	185 Third Avenue	1971 to present	Manufacturer of electric panel boards and switchboards.	1,1,1 Trichorlethane***	•1938 – Initial filing with State of NY •2009 – Active	P. Christopher Walsh Electric Switchboard Co. Inc. 185 3rd Ave Brooklyn, NY 11217-3095
71	George Wright & Sons Machine Corp. ** (ICS#: N-21777; NYC ID#: 14481)	479 Baltic Street	Circa 1979 to 1994	Manufacturer of plastic novelties, custom injection molding.	Hydrocarbons, isobutene, hexane, styrene, ehtylbenzene, methanol, ethylene glycol, nitrate compounds, etc.	•1979 – Initial filing with State of NY as George Wright & Son Machine Corp. •1994 – Merged with Mercury Plastics Corp. (surviving corporation) •2009 – Active	William Wright, CEO Mercury Plastics Corp. 995 Utica Avenue Brooklyn, NY 11203-4309
72	Hospital of the Holy Family** (ICS# P-26029; NYC ID#:19296)	155 Dean Street	1882 to present	Hospital 1882 until circa 1990, geriatric care center thereafter	Nuclear waste, pathological waste***	•1849 – Initial filing with State of NY as The Sisters of Charity of Saint Vincent De Paul of New York •2009 – Active	Sister Dorothy Metz, President Sisters of Charity Center 6301 Riverdale Avenue Bronx, New York, 10471-1093
73	Statewide Fireproof Door Co. Inc. ** (ICS#: N-21766; NYC ID#:14318)	131 Third Street	Circa 1999 to present	Metal doors sash frames & trim	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, and various solvents	•1965 – Initial filing with State of NY •2009 – Active	Phil Toy, Manager Statewide Fireproof Door Co. 131 3rd Street Brooklyn, NY 11231
74	Superseal Aluminum Industries Inc. ** (ICS#: N-21767; NYC ID#:14319)	55 4th Street	Circa 1970s to 1988	Metal fabrication	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, and various solvents	•1971 – Initial filing as Superseal Aluminum Industries Inc. •1988 – Merged with Superseal Manufacturing Co. Inc. (surviving corporation) •2009 – Active	Ronald Vespa, President Superseal Manufacturing Co. Inc. 125 Helen Street South Plainfield, NJ 07080
75	Italian Art Iron Work Inc. ** (ICS#: N-21814; NYC ID#:14072)	38-48 Bergen Street	Circa 1999 to present	Metal fabrication	Metal compounds, including zinc, copper, nickel, lead, etc. Xylene, methyl ethyl ketone, naphthalene, benzene, and various solvents	•1986 – Initial filing with State of NY •2009 – Active	Vincent Pampilonia, President Vinnie's Italian Art Iron Works Incorporated 38 Bergen Street Brooklyn, NY 11201

Table 3: Gowanus Canal Industries #1 Through 80

#	Operator at Gowanus	Location	Tenure*	Operations	Potential Contaminants	Succession History*	Agent of Service
76	RMC Canvas & Rope Co. Inc. ** (ICS#: N-21749; NYC ID#: 12155)	99 W. 9th Street	Circa 1980s to present	Manufacturer of cargo and safety nets, safety appliances	Xylene, methyl ethyl ketone, naphthalene, benzene, and various solvents	•1954 – Initial filing with State of NY •2009 – Active	RMC Canvas & Rope Co. 99 W. 9th Street Brooklyn, NY 11231
77	Zophar Mills, Inc. **	112-130 26th Street	Circa 1941 to 1990s	Manufacturer of coal tar resin, wax, and asphalt compounds	Cresylic acid, ethyl benzene, mineral spirits, petroleum asphalt, natural asphalt, petroleum waxes, naphtha***	•1924 – Initial filing with State of NY •2010 – Active	Charles W. Graman 510 Elms St. Cranford, NY 07016
78	Aetnacraft Industries, Inc. **	69 2nd Avenue	Circa 1971 to at least 1990	Metal fabrication	Solvents, copper cyanide, zinc cyanide, kerosene, sulfuric acid, muriatic acid, sodium bisulfate, Udylite Carrier 44N, Udylite Carrier 62A, Udylite Carrier FN, Udylite Ferro Nickel ***	•1931 – Initial filing with State of NY as Broadway Chromium Plating Co., Inc. •1969 – Changed name to Aetnacraft Industries, Inc. •2010 – Active	Aetnacraft Industries, Inc. c/o Wagner, Winick, Ginsberg, Ehrlich, Reich & Hoffman 1415 Kellum Place Garden City, NY 11530
79	F.M. Circuits Corp. **	152 11th Street	1968 to present	Electronic finishing and tooling	Alkaline etchant***	•2010 – Active	F.M. Circuits Corp. 152 11th Street Brooklyn, NY 11215
80	General Architectural Finishing Corporation **	120 13th Street	Circa 1978 to at least 1990	Metal fabrication	Chromates, toluene, xylene***	•1978 – Initial filing with State of NY •2010 – Active	General Architectural FinishingCorporation 9637 Conklin St. Farmingdale, NY 11735

Notes:

* Based on Currently Available Information

** Industrial Pretreatment Program Entity

*** Chemical use identified as a positive contributing industry in July 1984 NYSDEC Industrial Chemical Survey.

Table 4: DQO Process for Phase 1 Study

DQO Step	Output
1. State the problem	**Problem:** • The impact of CSO discharges on CERCLA-regulated compounds in the Gowanus Canal is not well known. This is due in part to the lack of appropriate data and a working CSM. • Ecological PRG for Total PAHs is based on a study with a high degree of uncertainty, including multiple confounding factors such as the presence of NAPL in the sediment. **Planning Team:** The planning team will involve: NYCDEP, USEPA Region 2, and NYDEC. **Conceptual Site Model (CSM)** The CSM for the site is underdeveloped and has led to incorrect conclusion about the impact of CSO discharge on the proposed remedy. In particular, the components of the CSM, such as a solids balance for the canal incorporating the rates of sediment accumulation, contaminant mass balance estimates for COPCs, and estimates of major external contaminant sources to the canal (from the three MGP sites, unpermitted and permitted pipes and groundwater) have not been quantitatively estimated. The lack of these components has resulted in flawed notion that any contribution of PAH contaminants is unacceptable and will compromise the preliminary proposed remedy, a site cap. In reality, deposition on the post-remediation cap surface will be comprised of solids from a number of sources, with the majority coming from Upper New York Bay via tidal action, as is now the case. **Identifying Deadlines and Constraints** • New data need to be collected and evaluated to assess the relative impact of sources on the canal. • Data are required in time to allow detailed evaluation of proposed remedy and source control impacts. • EPA intends to issue a proposed plan and a ROD by March 2013.
2. Identify the Goals of the Study	**Principal Study Questions:** • What are appropriate COPC PRGs for sediments in the canal? • What will be the likely concentration of contaminants in surface sediments if the main

	upland sources are controlled, exclusive of the CSOs? • Given sufficient control of the upland sources, how much must the CSO discharges be reduced to meet the PRGs for surface sediments? • What is the fractional contribution of CSO solids to annual deposition in the Canal? • How does the fractional contribution of CSO solids to annual deposition in the Canal vary with distance along the Canal? **Subordinate Study Questions** • What is the distribution of contaminants in the dissolved and particulate phases for CSOs, and SWOs? • What are the contaminant fingerprints on particulates from the various CSOs that discharge into the canal? • What are the impacts of NAPL on CSOs around the Fulton MGP sites? • What are the solids and contaminant loads from the CSOs and other sources? • How do the contaminant fingerprints from CSOs compare to recently-deposited surface sediment samples in the Canal and Bay? • How do the contaminant and solids concentrations, and loads vary with rainfall intensity in the CSOs? **Program Goals:** • Establish the fractional contributions of CSO and harbor solids in recently deposited sediment over the length of the Canal. • Characterize the COPC concentrations in dissolved and suspended matter in CSO effluent. • Estimate the annual loads of COPCs to the Canal. • Investigate the impact of NAPL/Fulton MGP Site on the CSOs. • Characterize the COPC concentrations and patterns of recently deposited sediments in Gowanus canal and Gowanus Bay. • Redevelop sediment PRGs to reduce uncertainties associated with PRGs developed by EPA. • Develop current solids and contaminant mass balances that will lead to a CSM for the site. • Provide data to support proposed remedial decision. • Determine NAPL impact on CSOs. **Alternative Actions:**

	The following alternative actions could result from resolution of the principal study questions: • Refinement of CSM. • New PRG will aid in assessing the impacts of CSO discharge. • Knowledge of the relative magnitude of CSO contribution will aid in assessing their impact on any future remedy and permit an assessment of CSO impacts following the planned discharge reduction and water quality improvement programs. • Quantification of the degree of CSO reduction required to meet the PRG. . **Decision Statements:** • If the relative contribution of solids and COPCs from the CSOs are currently small, further investigation to establish the dominant solids and COPC pathways is needed. • If future surface sediments concentrations in the absence of upland sources are estimated to exceed the PRG, reduce the CSO loads sufficiently to fall below this criterion. If surface sediments are not forecast to exceed the PRG, no further action on the CSOs is needed with respect to CERCLA.
3. Identify the information inputs	**Information Required:** Information necessary to answer the decision statements will include the data from the planned Phase I program and existing or other planned field data that are relevant to answering the program questions. **New Data Needed:** • Time composite wet weather sampling for dissolved-phase and particulate-phase contaminant concentrations at CSO/SWO discharge sites. • Dry weather contaminant concentrations in CSOs up and down interceptors at Fulton Street MGP site. • Toxicity data and sediment physical characteristics to redefine/reduce uncertainty in sediment PRG. • Contaminant concentrations and grain size distributions of recently deposited sediments (Be-7 bearing) along main axis of Canal. • Contaminant concentrations and grain size distributions of recently deposited sediments (Be-7 bearing) outside the Canal to characterize harbor solids

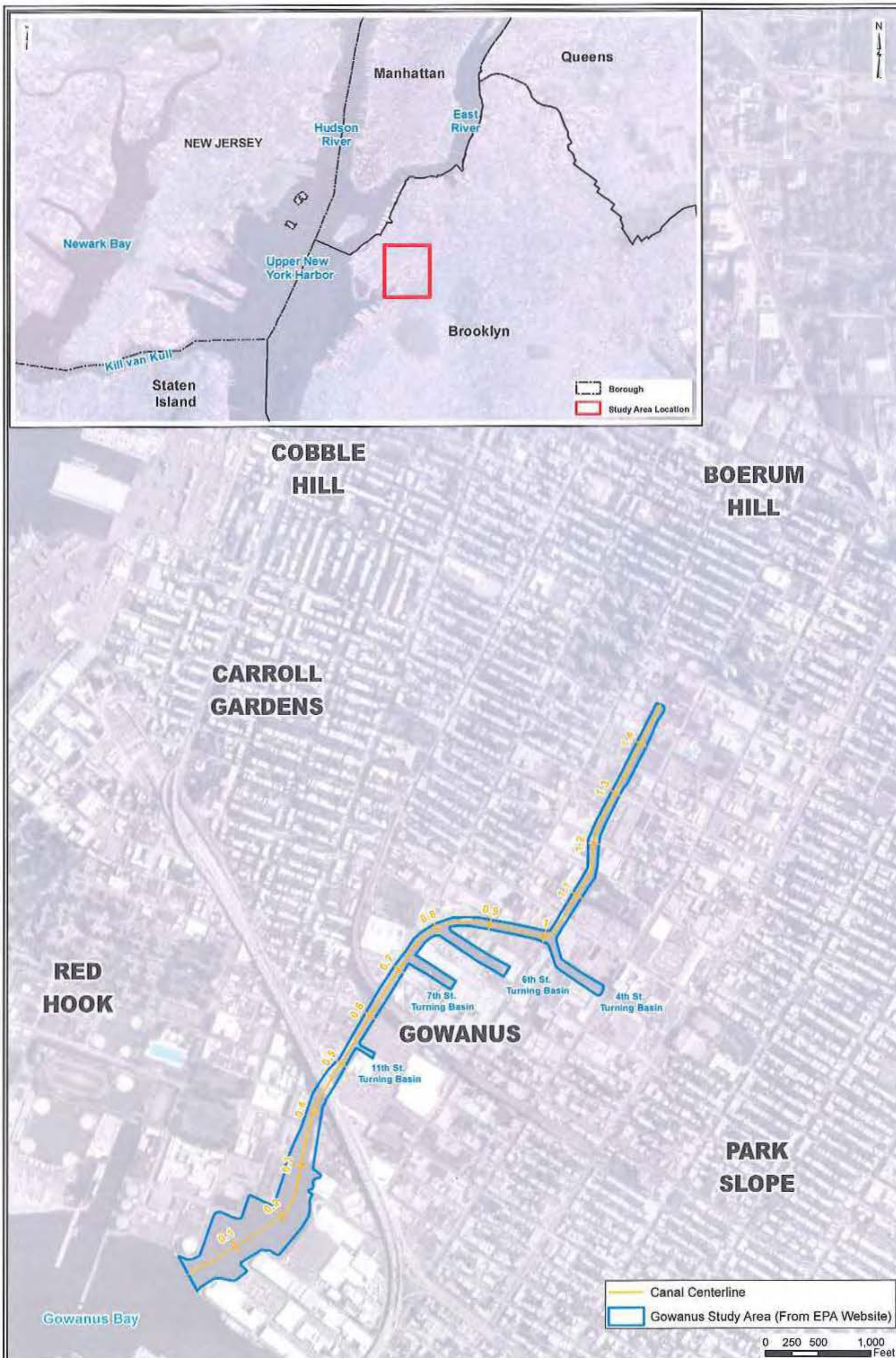
	Existing Data: • USEPA RI/FS surface sediment data in the Canal and harbor • USEPA and other subsurface COPC data in the Canal • Pore-water data and groundwater COPC concentrations • Bathymetry data. • National Grid sediment data
4. Define the Study Boundaries	**Geographical Area:** The Study Area comprises the Gowanus Canal Superfund Site including: the Canal, the interconnecting waters (Gowanus Bay, the Buttermilk Channel), the CSOs, stormwater outfalls, other discharges, and industrial discharges. **Time Frame and Sample Type:** Data collection will start in summer 2012 through spring 2013. CSO sampling will be wet weather sampling as follows: • CSOs RH-034, OH-007, OH-006, and RH-031 will be sampled at a higher frequency – Minimum of 4 wet weather samples • Remaining CSOs will be sampled for at least two wet weather events • Samples will be analyzed for dissolved and particulate phase • Time-composite samples will be collected. Investigate the impact of NAPL/Fulton MGP Site on the CSOs: • Will focus on potentially impacted CSOs - RH-033, RH-037, and RH-038 • Stormwater sampling to assess the PAH concentration in the watershed – Min. 3 samples. • Dry weather sampling – Min. of 3 samples • Dry weather flow entering sewage flow regulators R23, R24 and R25 • Influent to small pumping station which receives the dry weather flow from the Fulton MPG site

	Recently Deposited Sediments: • Collect recently deposited sediments (Be-7 bearing) along main axis of Canal. • Collect recently deposited sediments (Be-7 bearing) outside Canal to characterize harbor solids. • Collect minimum of 30 Canal and 15 harbor samples • Analyze about 20 Canal and 10 harbor samples for COPCs and possible CSO particle tracers • A minimum of 4 wet weather samples for the larger CSOs (RH-034, OH-007, OH-006, and RH-031) and a minimum of 2 wet weather samples for the others. Toxicity Testing Program includes surface sediments at: • Five Previously Sampled Reference Stations • Twelve Previously Sampled Gowanus Canal Stations • Other Canal locations where NAPL inclusions or sheens are not present.
5. Develop the Analytical Approach	**Chemical Parameters:** • PAHs (primary and alkylated) • Total petroleum hydrocarbons • Volatile organics (NAPL impacted CSOs only) • Metals (TAL + Hg) • PCBs • TOC • TSS • Grain size distribution of solids • Radionuclide analysis on CSO solids and surface sediments (Be-7, Cs-137, K-40 , and Th234) • Potential CSO particle tracers (we are currently evaluating tracers that can be used to trace CSO particles) • Chronic Toxicity Testing (*Leptocheirus plumulosus*) **Analytical Approach:** Approach will be detailed in QAPP

	Project Quantification Limits and QA/QC: This will be specified in the QAPP.
6. Specify Performance or Acceptable Criteria	**Potential Source of Error in Data:** Sampling Error • Time composited sampling of CSO discharge will reduce variability associated with individual large-volume water grab samples which represent a "snap-shot" in time • The collection of several large volume samples at each location will provide a measure of the variability of the mean contaminant concentrations if conditions are time dependent. • Sample sizes should be of sufficient volume, and analytical detection limits of sufficient sensitivity to obtain detected concentrations of most PAH compounds and metals. Measurement Error To control measurement error, a rigorous QA/QC process will be implemented as detailed in the QAPP. Decision Error The data will be used to augment existing field data and to develop a defensible CSM. Results will be used to guide the decision making process on the impact of CSO on proposed remedy. Decision error will ultimately be minimized through a weight-of-evidence approach, which incorporates all the pertinent information. **Additional Uncertainties:** • Occurrence and duration of wet-weather events may affect sample collection windows and averaging intervals.
7. Describe the Plan for obtaining the Data	Detailed plan to be describe in sampling program and standard operating procedures will be provided in a sampling plan.

Table 5. Previously Observed Chemical and Physical Characteristics for Ecological Toxicity Sampling Locations

Station	Total PAH (ppb)	Field Log Grain Size Estimate	Field Log Presence of Sheen	Survival in Prior Toxicity Testing
Reference Area				
326	1,890	Clayey sand	No Sheen	70
328	7,840	Silty clay	No Sheen	75
329	33,430	Silty clay	No Sheen	91
330	4,210	Silty clay	No Sheen	92
333	4,410	Silty clay	No Sheen	77
Gowanus Canal				
303	39,370	silt	Slight Sheen on water and sediment	81
307A	29,090	Silt	No Sheen	79
307B	28,690	Silt	Slight Sheen	70
309	13,750	Silt	No Sheen	86
310	66,900	Silt	No Sheen	27
313	13,070	Silt	Sheen; PHC odor; PID=12	0.6
314	3,559,050	Silt	Heavy Sheen; Tar-like odors; PID=5	0
315	6,669,600	Silt	Sheen; Tar-like odor; PID=28.3	0
318	235,500	Silt	Sheen; PID=3	35
319	289,300	Silt	Sheen	53
321	33,890	Silt	Slight Sheen	69
324	13,095	Silt	No Sheen; septic odor	85



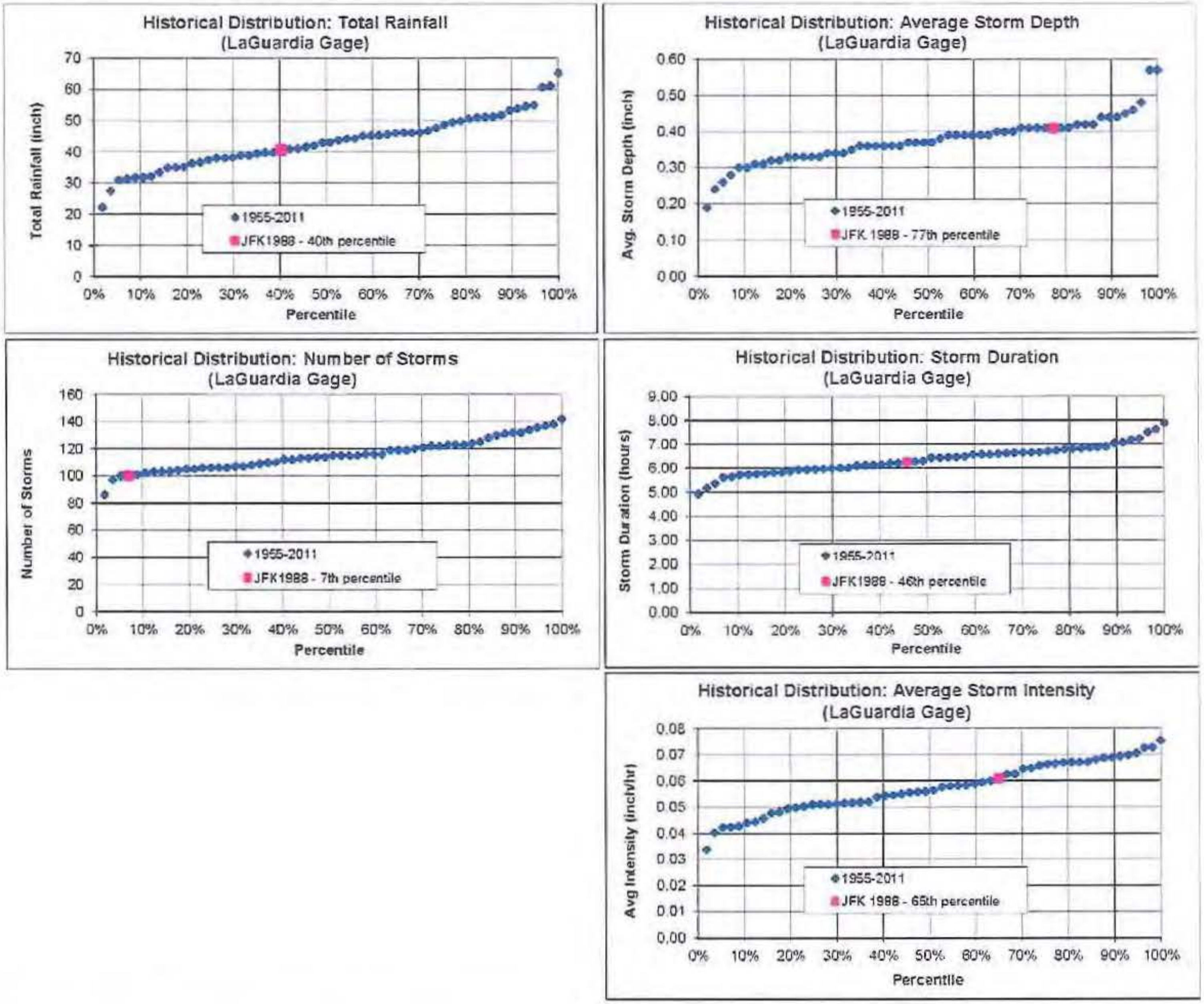
NYC Environmental Protection

Study Area Location Map

Draft – For Discussion Purposes Only

Figure 1

May 2012



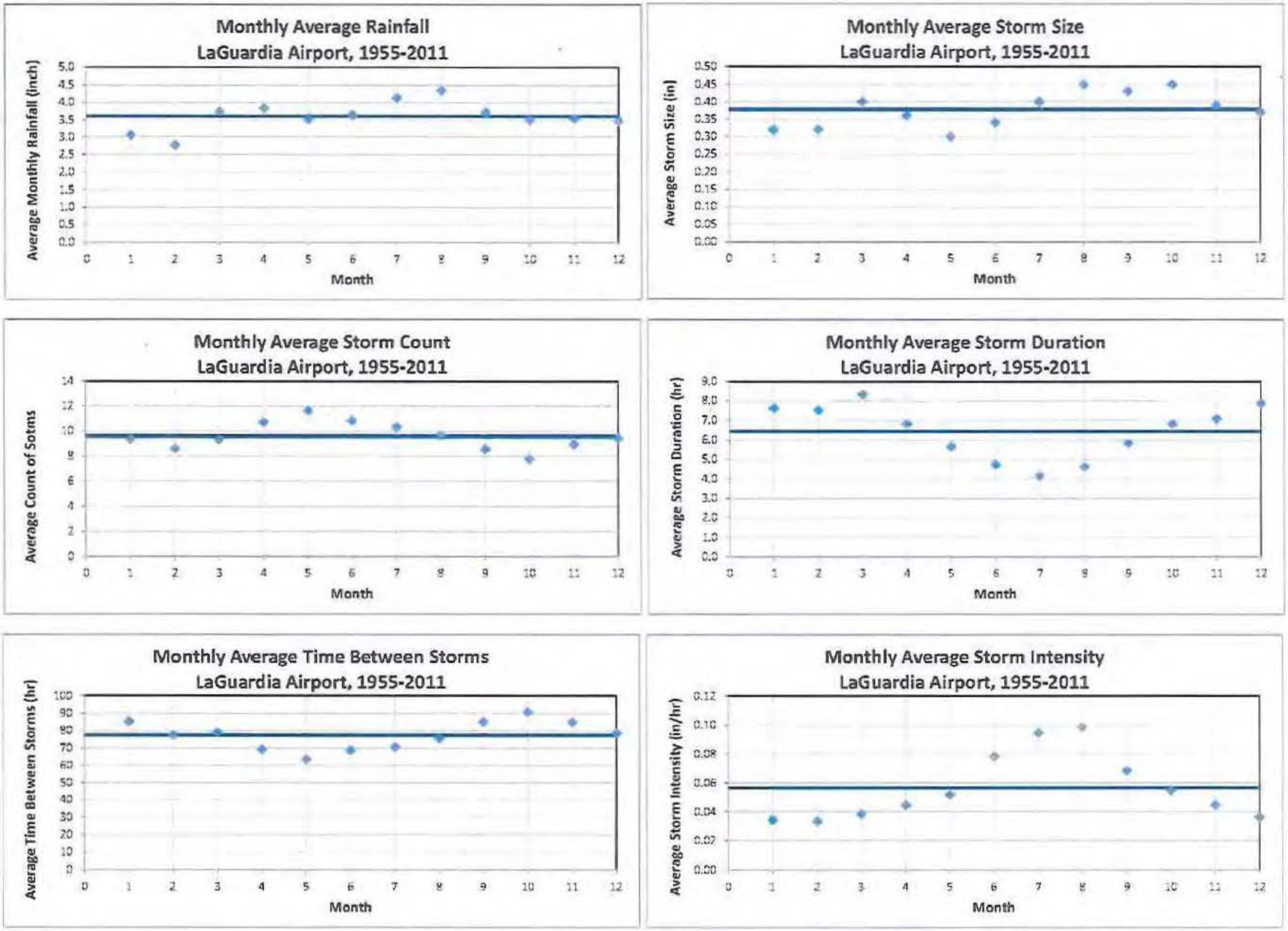
NYC Environmental Protection

Historical Distribution of Annual Average Rainfall Statistics,
LaGuardia Airport, 1955-2011

Gowanus Canal Superfund Site

Figure 2

May 2012



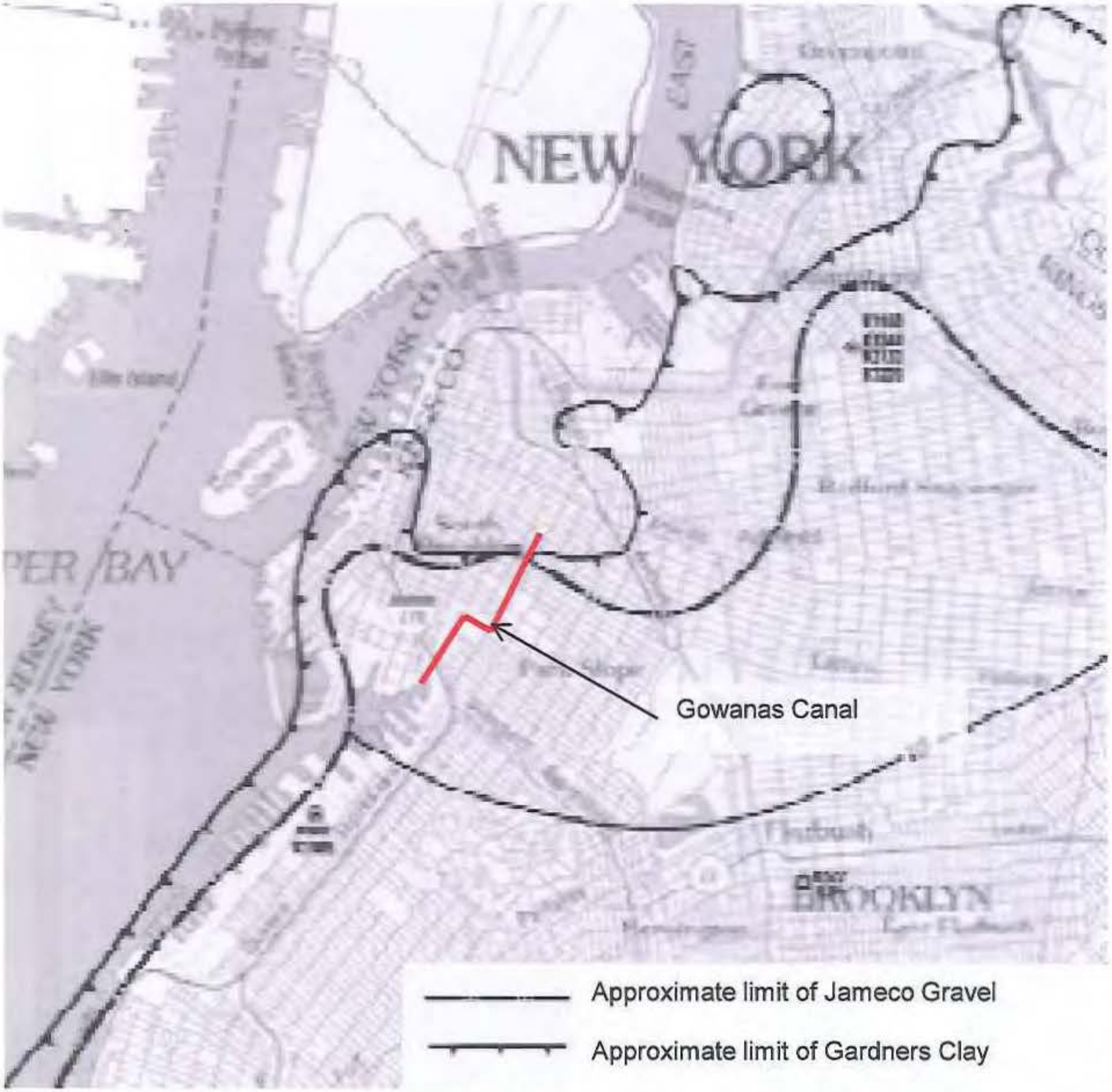
Environmental Protection

Monthly Rainfall Statistics, LaGuardia Airport, 1955-2011

Gowanus Canal Superfund Site

Figure 3

May 2012



Legend

Notes

Source: Buxton, H. T. and Shernoff, P. K. ,1999. "Ground-Water Resources of Kings and Queens Counties, Long Island, New York." Water-Supply Paper 2498. 1999.

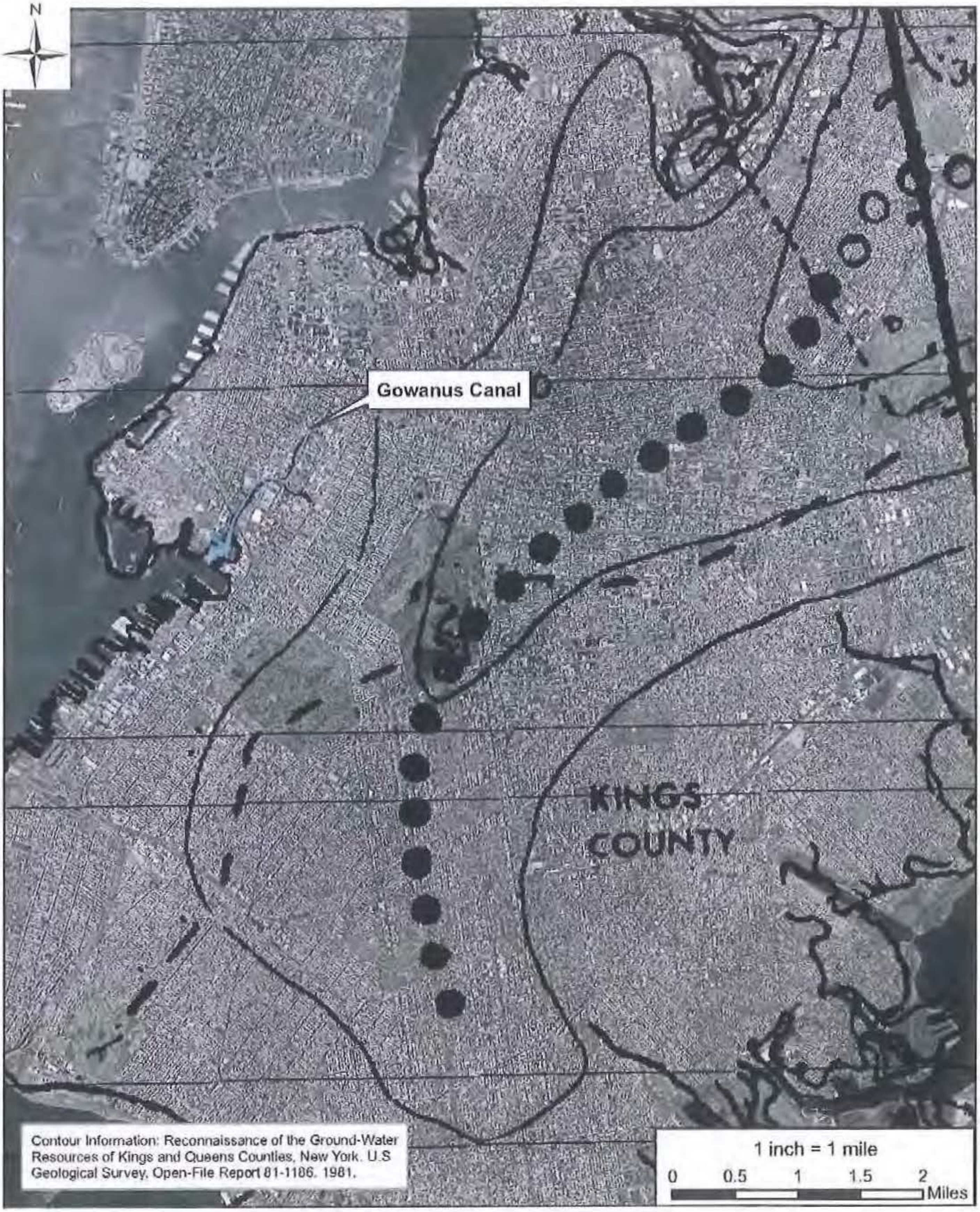
NYC Environmental Protection

Extent of Jameco Gravel and Gardeners Clay Relative to the Gowanus Canal

Gowanus Canal Superfund Site

Figure 4

May 2012



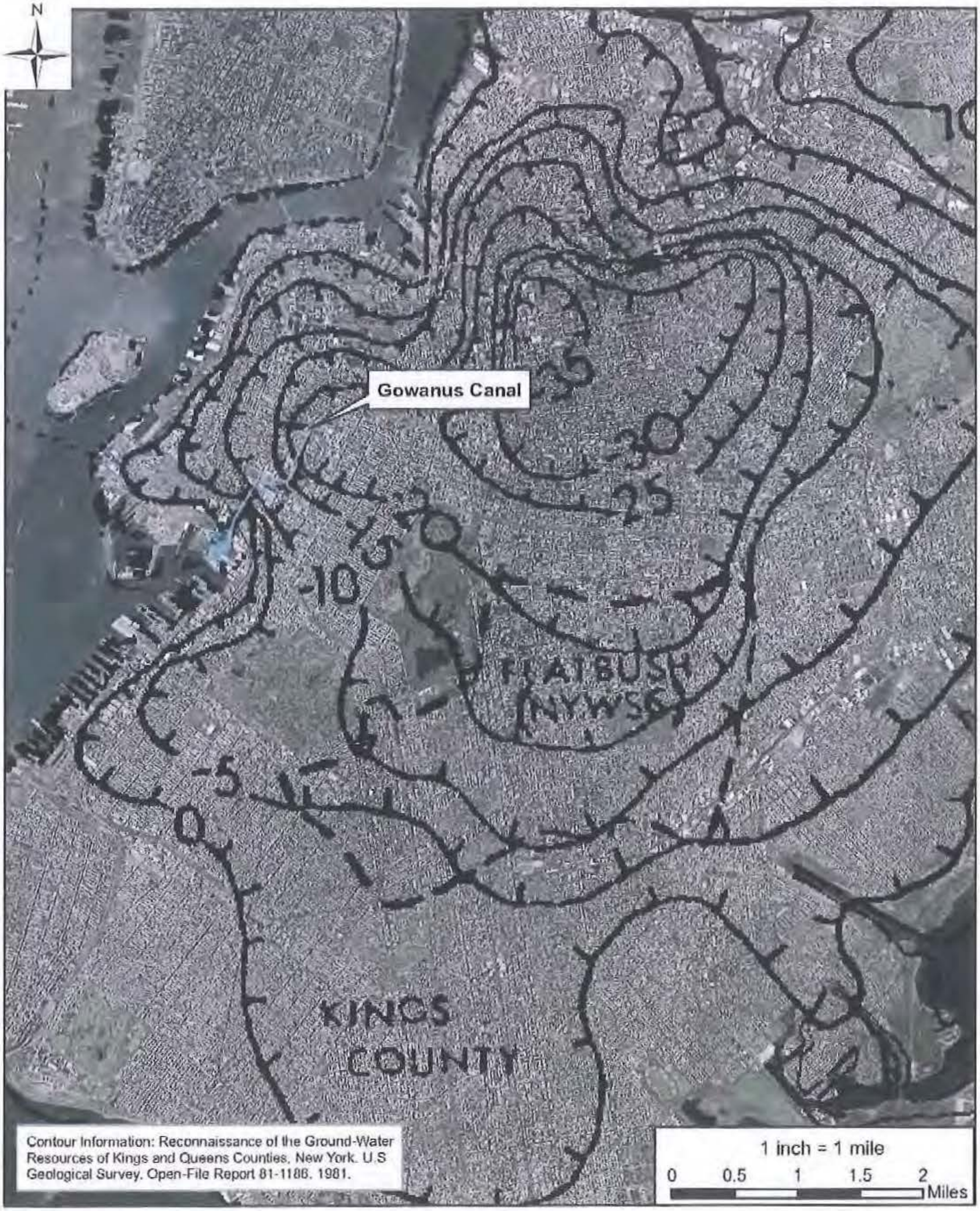
NYC Environmental Protection

Groundwater Elevation Contours 1903

Gowanus Canal Superfund Site

Figure 5

May 2012

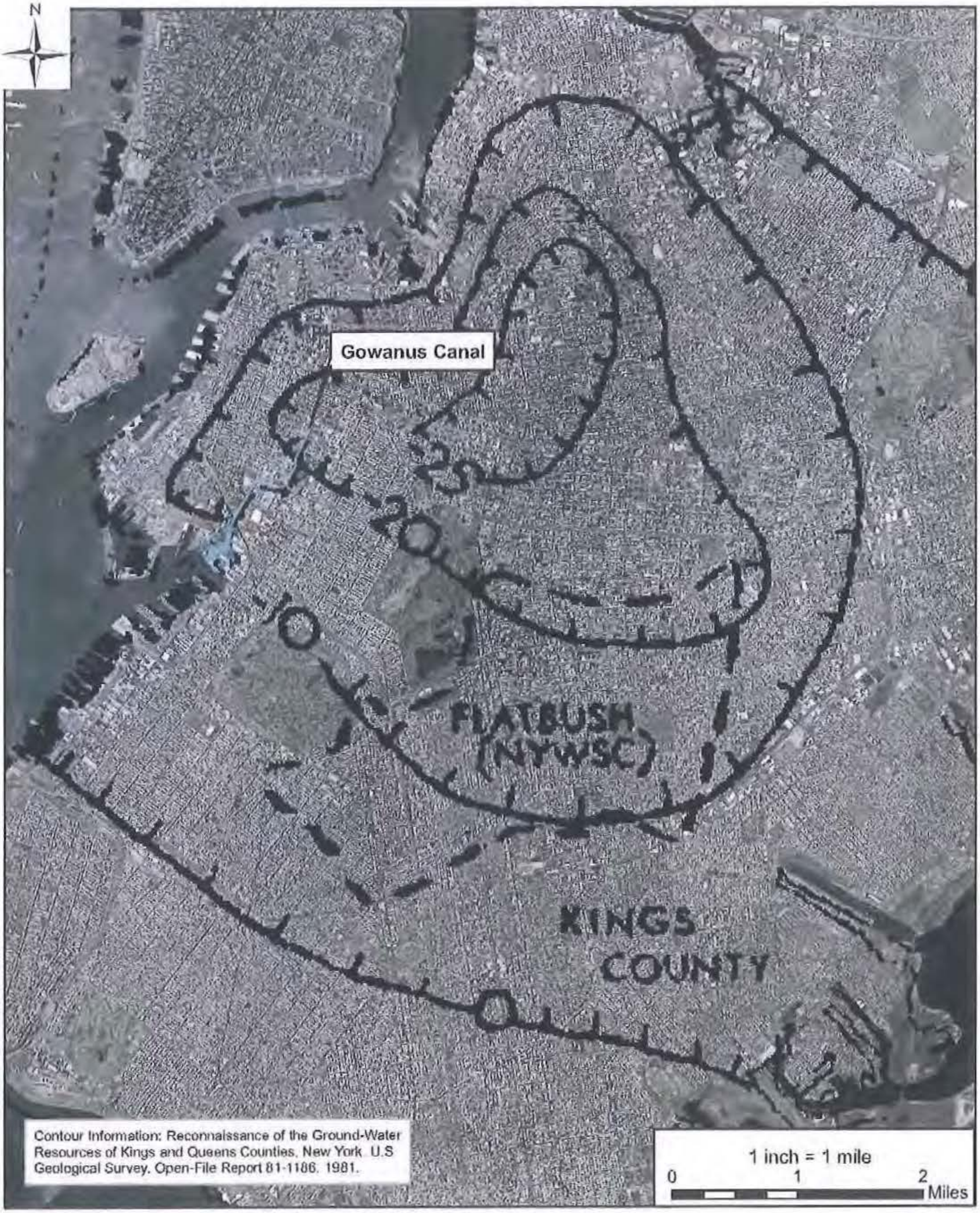


Groundwater Elevation Contours 1936

Gowanus Canal Superfund Site

Figure 6

May 2012



Groundwater Elevation Contours 1943

Gowanus Canal Superfund Site

Figure 7

May 2012

NYC Environmental Protection

Groundwater Elevation Contours 1951

Gowanus Canal Superfund Site

Figure 8

May 2012

Groundwater Elevation Contours 1961

Gowanus Canal Superfund Site

Figure 9

May 2012

NYC Environmental Protection

Groundwater Elevation Contours 1974

Gowanus Canal Superfund Site

Figure 10

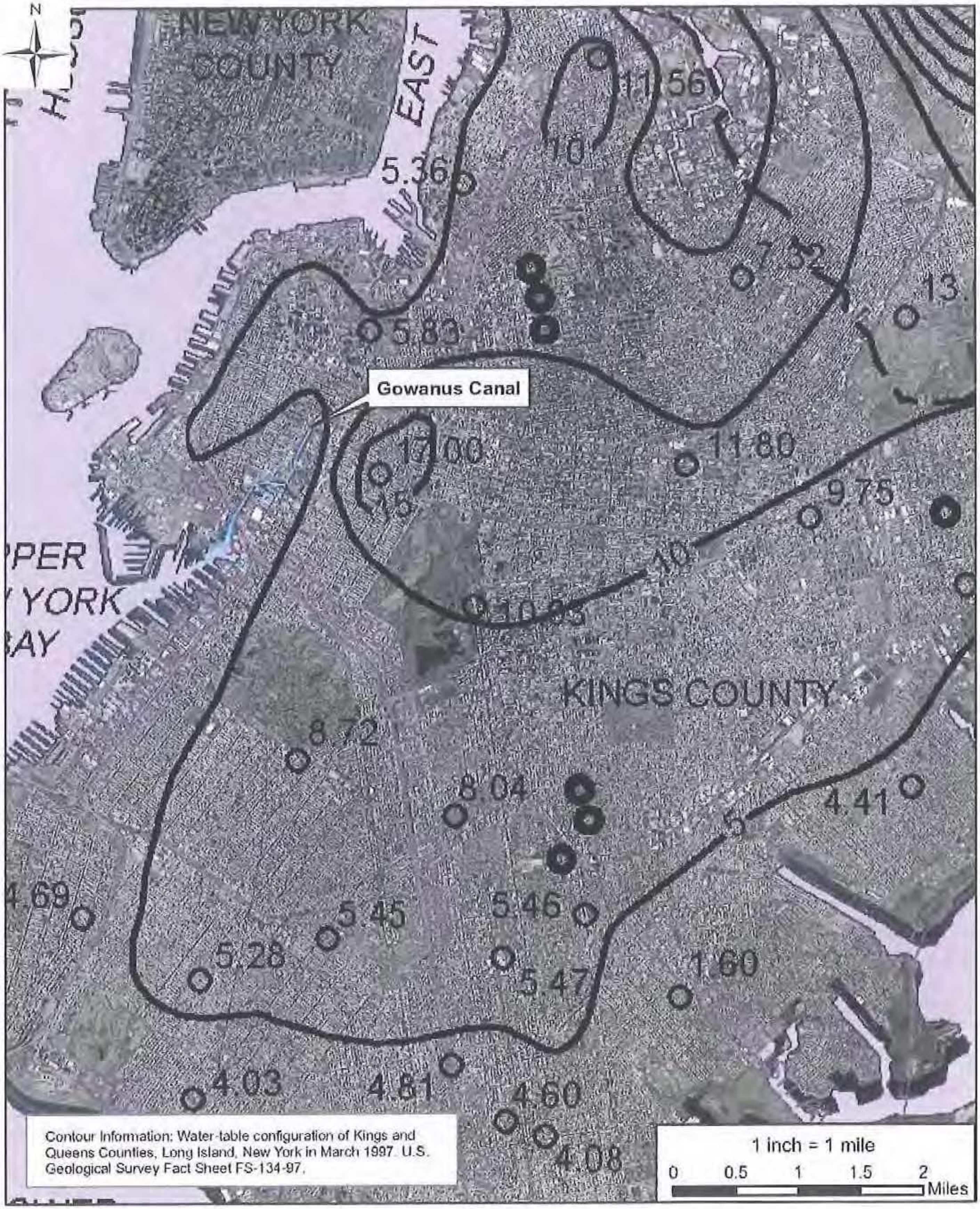
May 2012

Groundwater Elevation Contours 1981

Gowanus Canal Superfund Site

Figure 11

May 2012



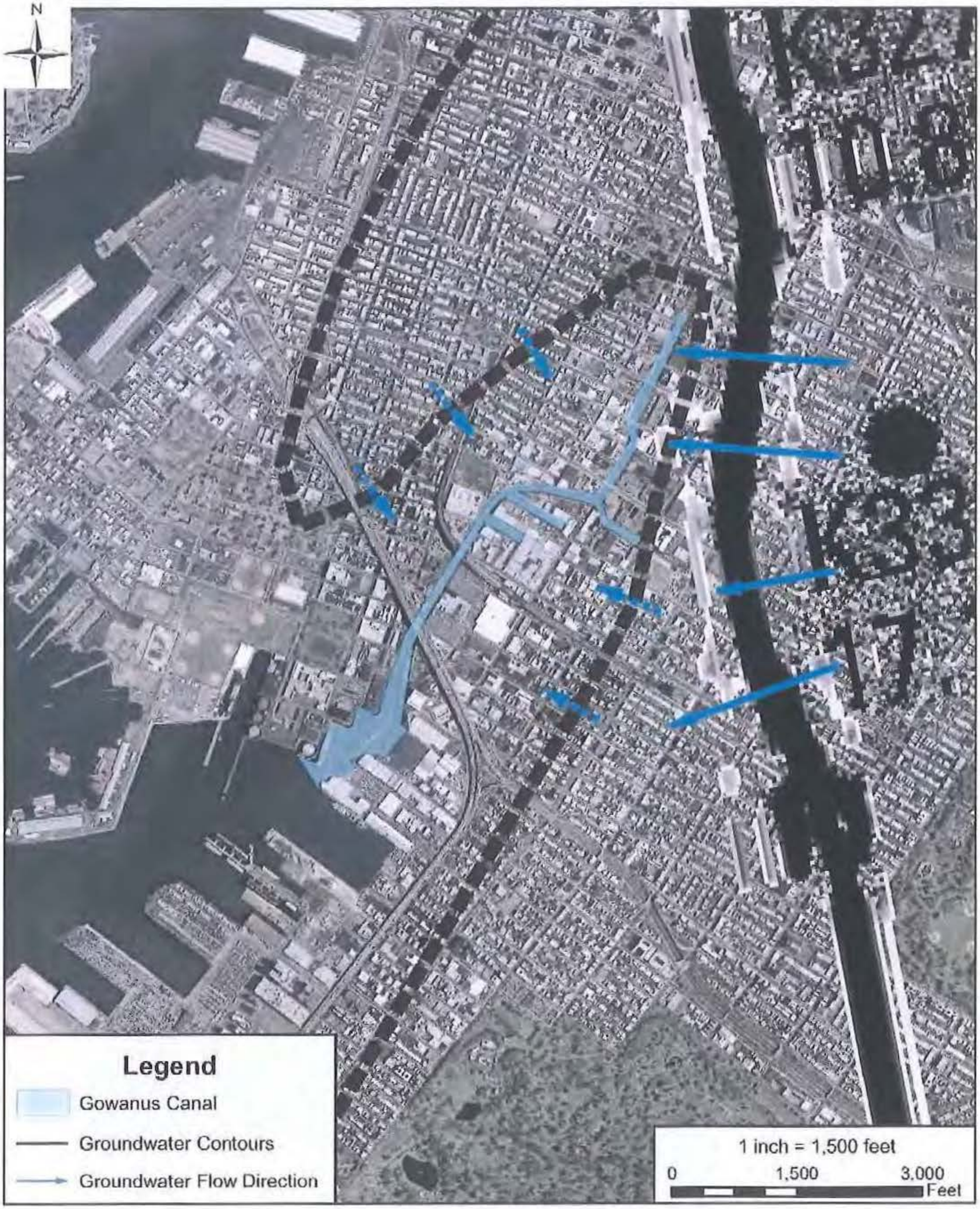
Groundwater Elevation Contours 1997

Gowanus Canal Superfund Site

Figure 12

May 2012

NYC Environmental Protection	**Groundwater Elevation Contours 2006** *Gowanus Canal Superfund Site*	Figure 13a May 2012

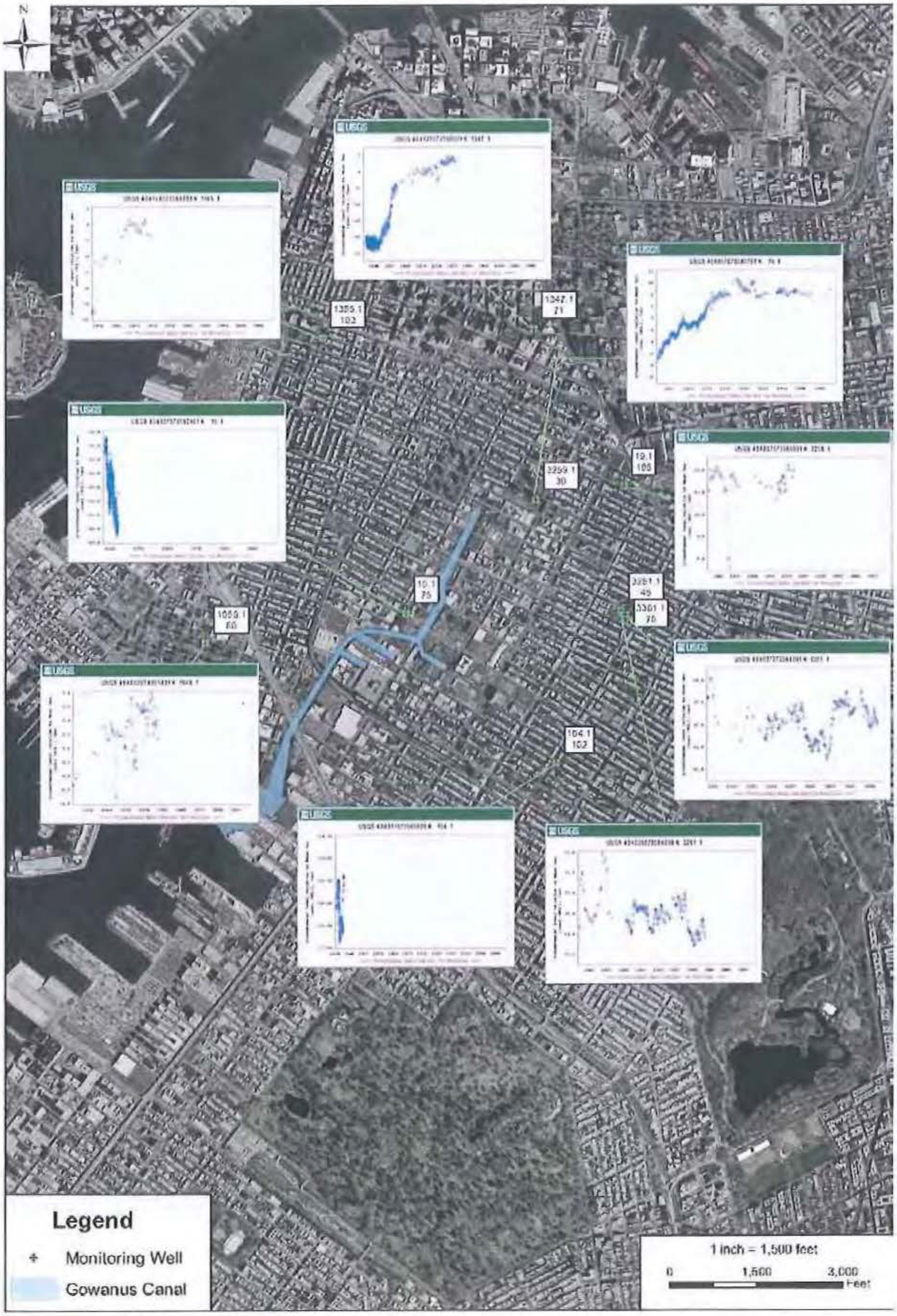


Groundwater Elevation Contours 2006

Gowanus Canal Superfund Site

Figure 13b

May 2012



Historical Groundwater Levels

Gowanus Canal Superfund Site

Figure 14

May 2012

Legend

- 1 & 2 Family Residential
- Multi-family Residential
- Mixed Use
- Open space & outdoor recreation
- Commercial
- Institutions
- Industrial
- Parking
- Transportation / Utilities
- Vacant Lots

Notes:

Source: NY City Department of Planning. NYC Oasis Map accessed on May 2012

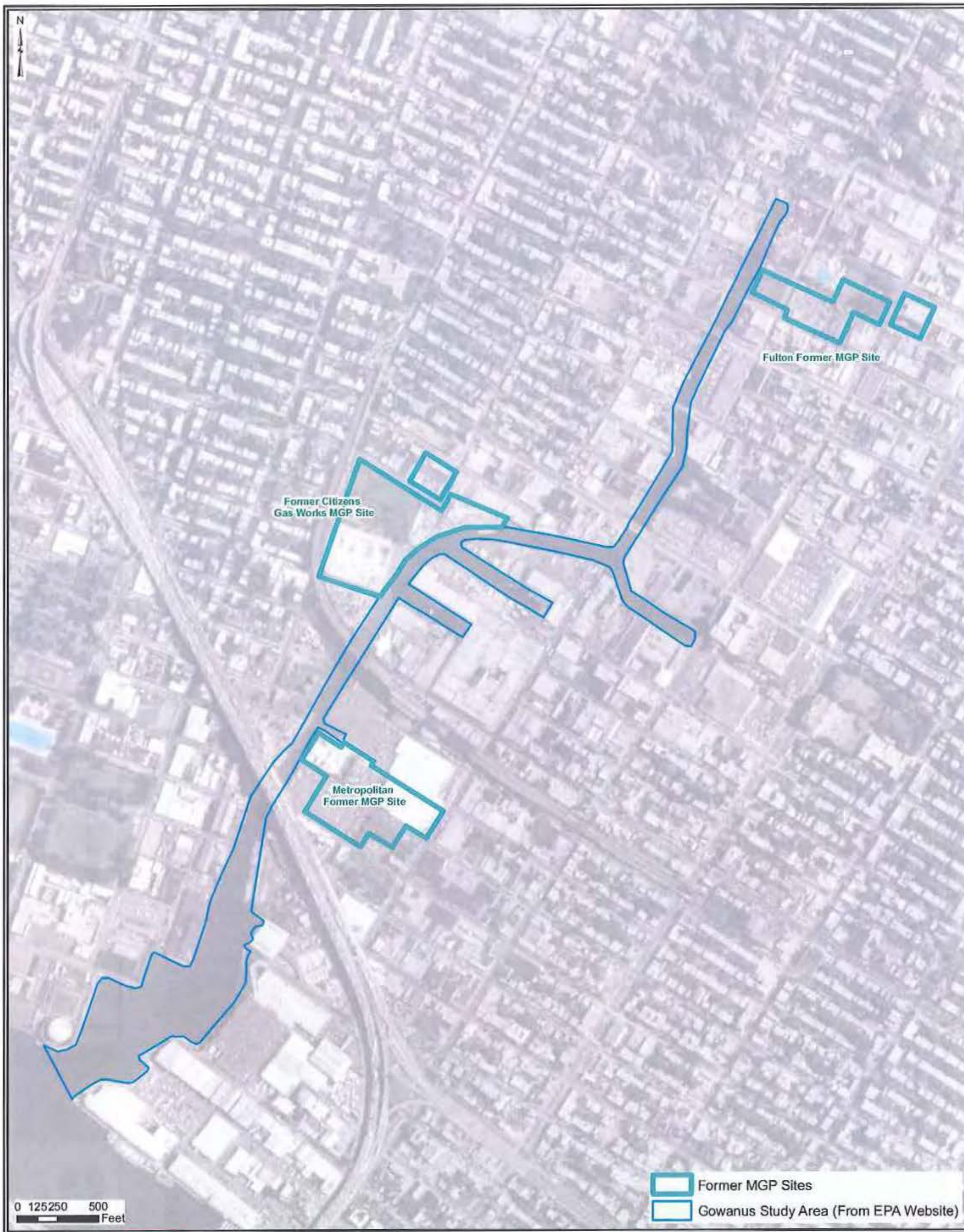
NYC Environmental Protection

Land Uses in the Gowanus Canal Drainage Area

Gowanus Canal Superfund Site

Figure 15

May 2012



NYC Environmental Protection

Location of Former MGP Sites Along the Canal

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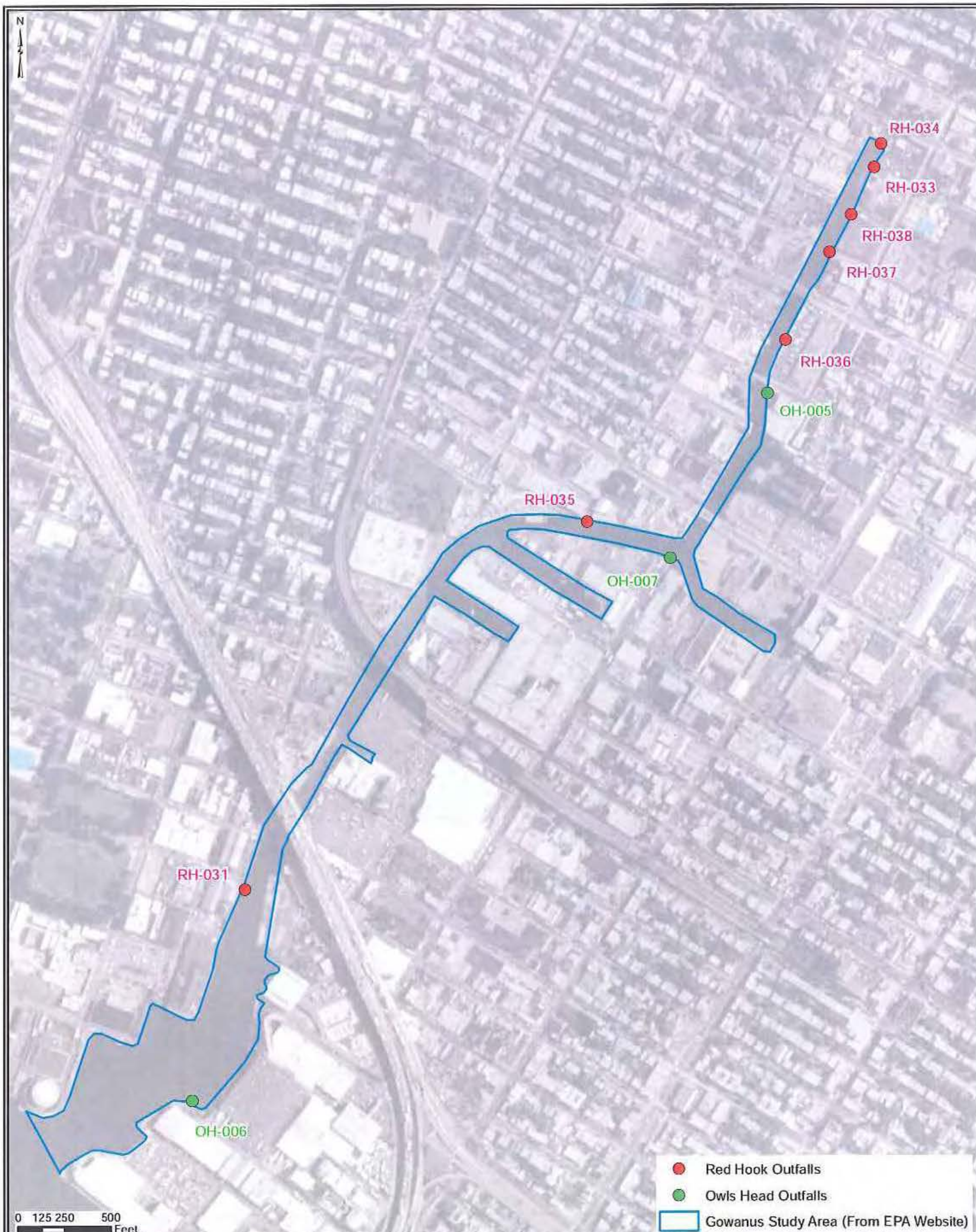
Figure 16

May 2012



CSO Outfalls Along the Canal

Draft – For Discussion Purposes Only

Figure 17

May 2012

GOWANUS INDUSTRIES #66-80

66. Scranton & Lehigh Coal Co., Inc./Patterson Fuel Oil Co.
67. Metal Package Corp.
68. Dale Lehigh Coal Co., Inc.
69. Commonwealth Fuel Co.
70. Electric Switchboard Co. Inc.
71. George Wright & Sons Machine Corp.
72. Hospital of the Holy Family
73. Statewide Fireproof Door Co. Inc.
74. Superseal Aluminum Industries Inc.
75. Italian Art Iron Work Inc.
76. RMC Canvas & Rope Co. Inc.
77. Zophar Mills, Inc.
78. Aetnacraft Industries, Inc.
79. F.M. Circuits Corp.
80. General Architectural Finishing Corp.

70-80 Industrial Pretreatment Program Entities

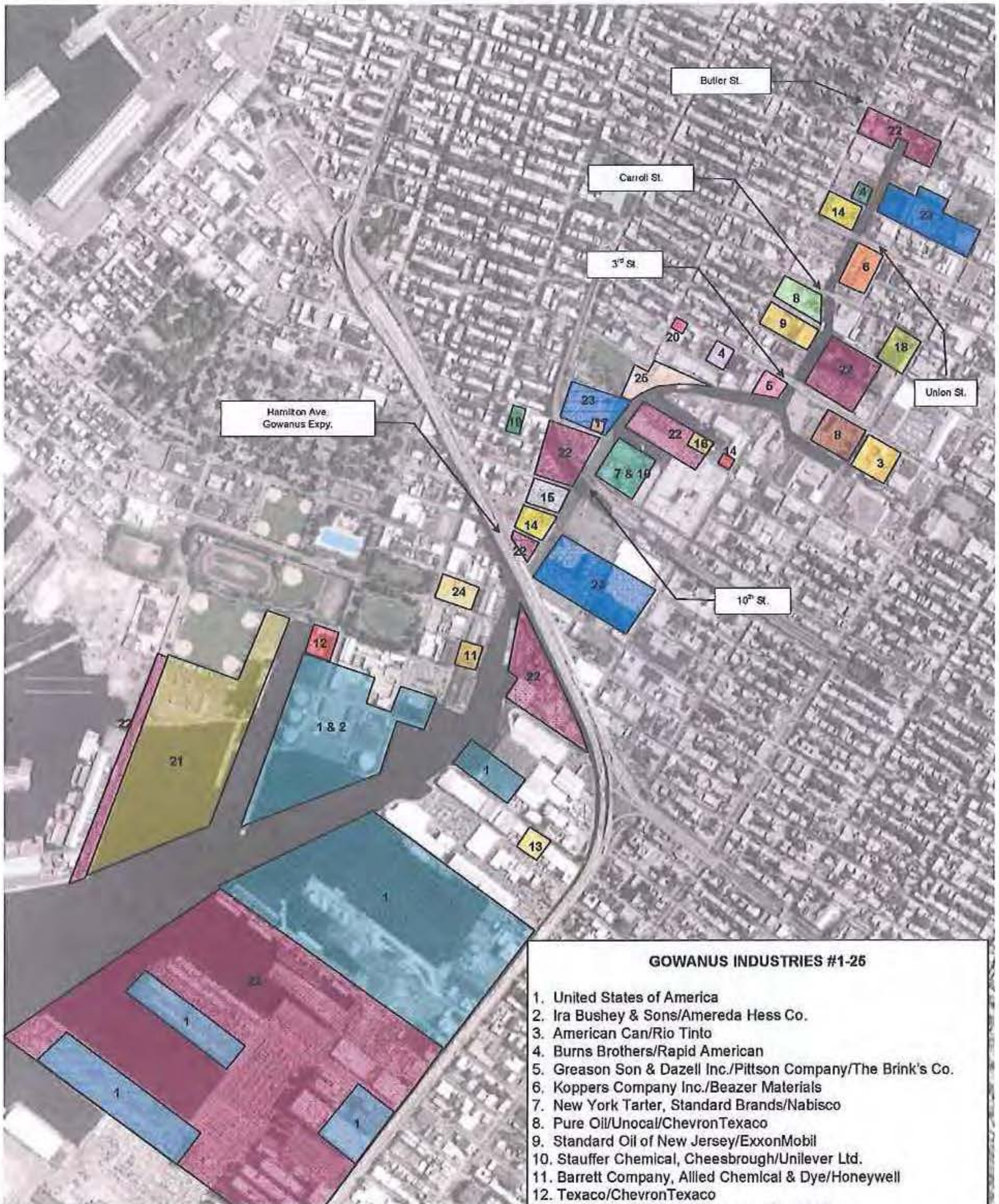
NYC Environmental Protection

Additional Upland Sources along Gowanus Canal Identified by GEI

Gowanus Canal Superfund Site

Figure 18a

May 2012



Aerial Photo Source: USDA- 2006

GOWANUS INDUSTRIES #1-25

1. United States of America
2. Ira Bushey & Sons/Amereda Hess Co.
3. American Can/Rio Tinto
4. Burns Brothers/Rapid American
5. Greason Son & Dazell Inc./Pittson Company/The Brink's Co.
6. Koppers Company Inc./Beazer Materials
7. New York Tarter, Standard Brands/Nabisco
8. Pure Oil/Unocal/ChevronTexaco
9. Standard Oil of New Jersey/ExxonMobil
10. Stauffer Chemical, Cheesbrough/Unilever Ltd.
11. Barrett Company, Allied Chemical & Dye/Honeywell
12. Texaco/ChevronTexaco
13. Debevoise Company/Seagrave Corporation.
14. Bayside Fuel Oil Corp./Bayside Fuel Oil Depot Corp.
15. Cirillo Brothers/Cibro Petroleum
16. Metropolitan Petroleum
17. American Agriculture Chemical Co./DuPont
18. American Nickel Alloy Mfg. Co./Algrun Metals & Minerals Corp.
19. Doehler Die Casting/NL Industries, Inc.
20. Atlantic Oil Works, American Oil Co./BP
21. State of New York
22. City of New York
23. Brooklyn Union Gas/National Grid
24. Woolsey Marine Industries, Inc.
25. Ferrara Brothers Building Materials Corp.

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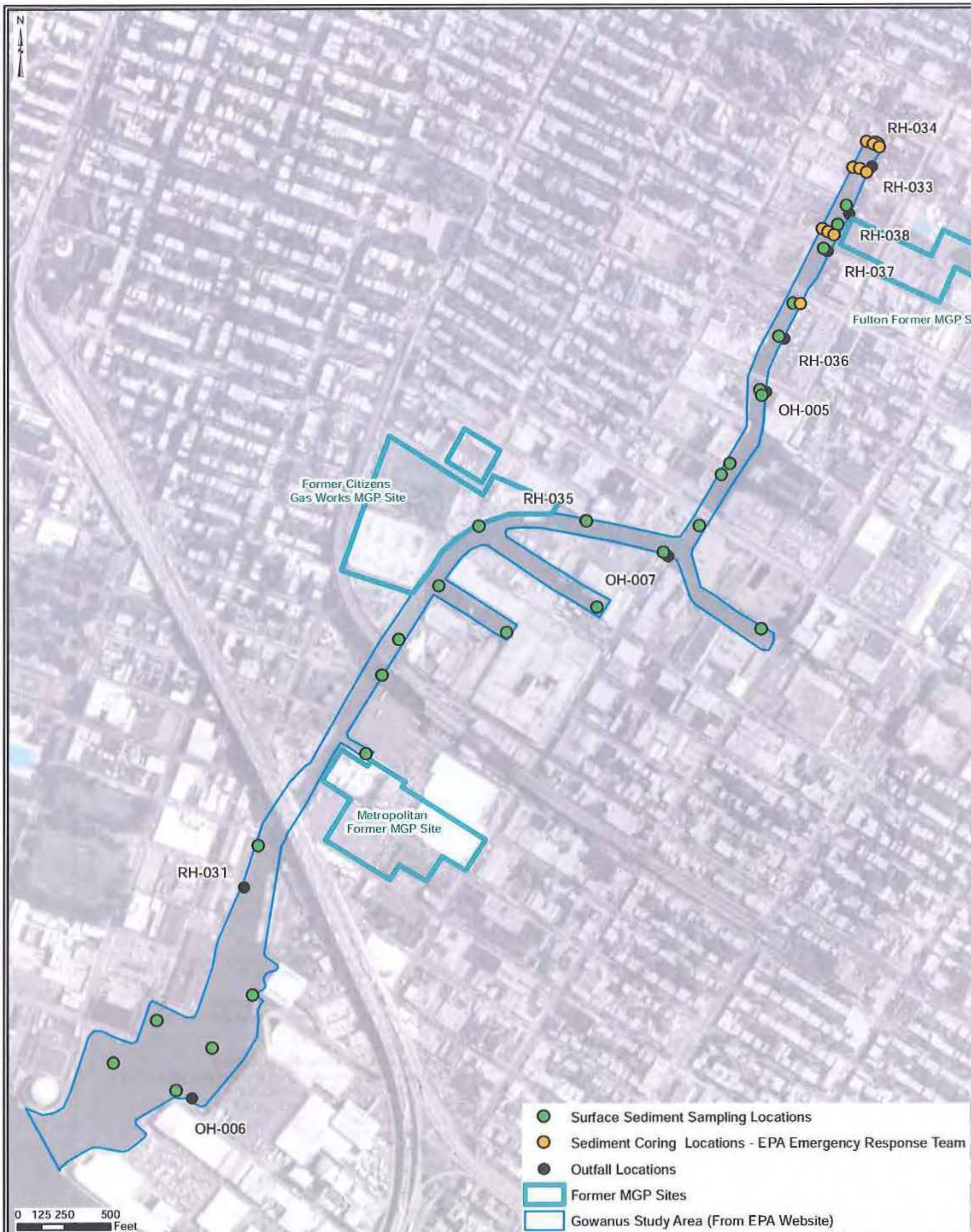
Additional Upland Sources along Gowanus Canal Identified by GEI

Gowanus Canal Superfund Site

Figure 18b

May 2012



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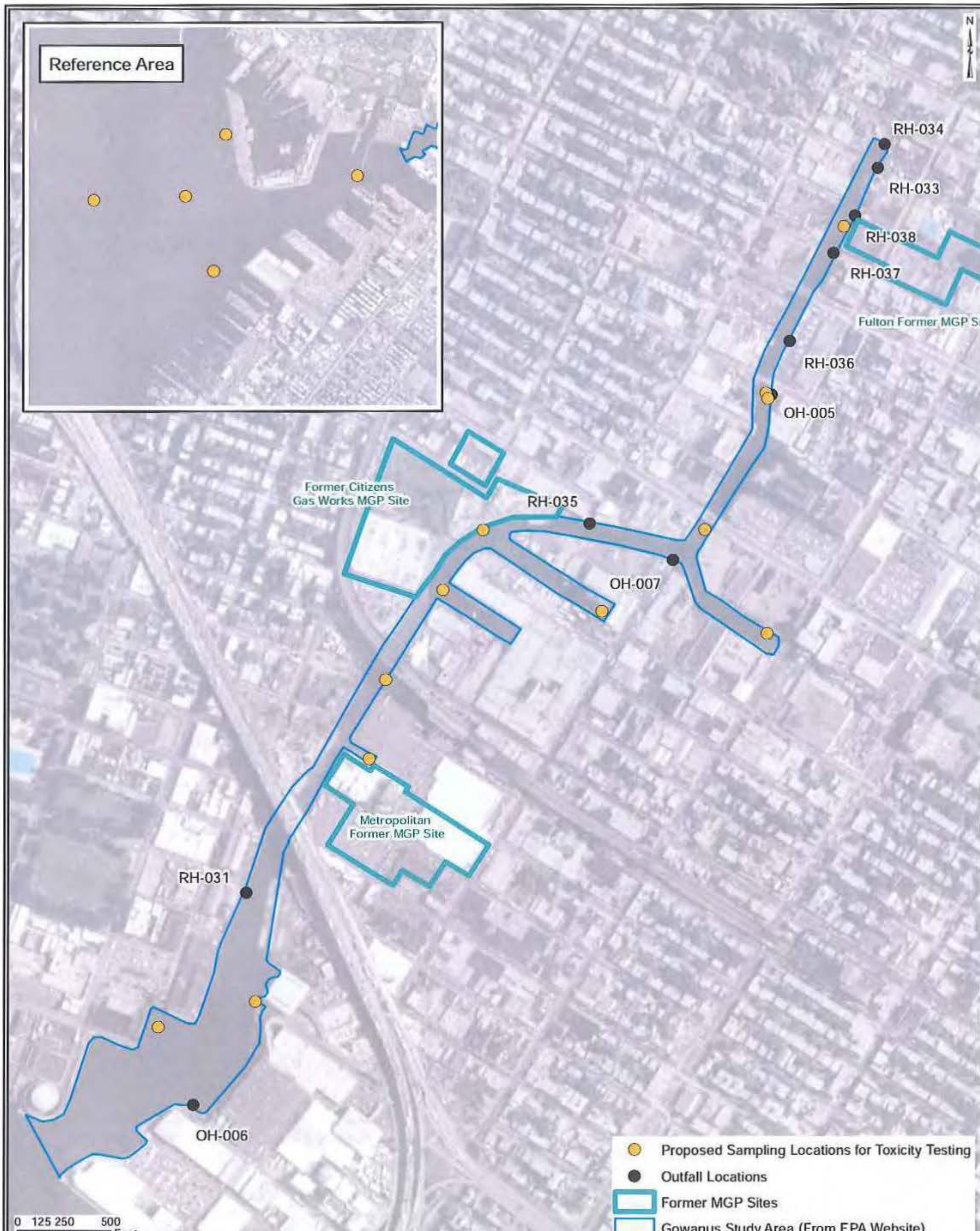
Surface Sediment Sampling Location - EPA RI

Draft – For Discussion Purposes Only

Figure 19

May 2012



Proposed Sampling Locations for Ecological Toxicity Test

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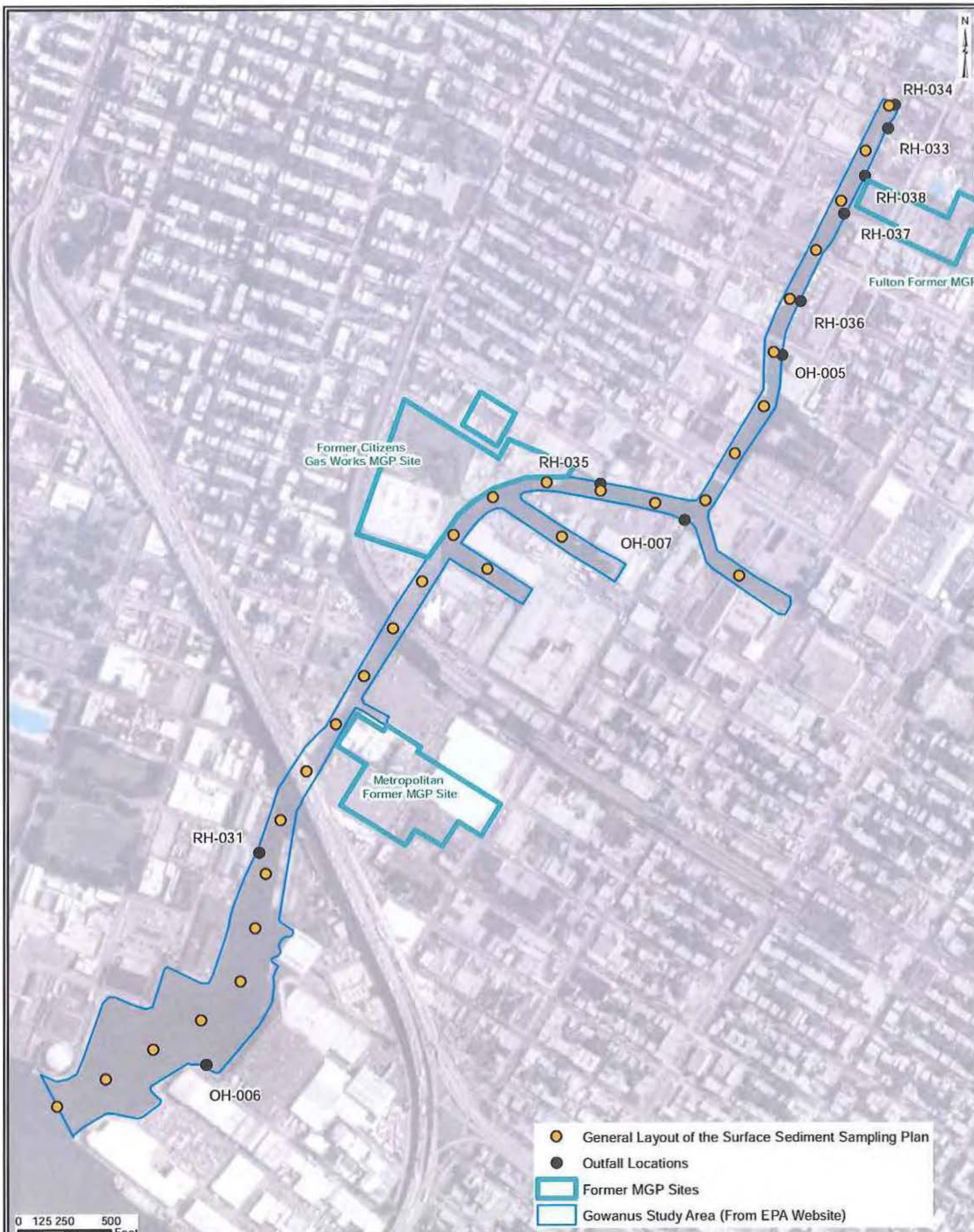
Figure 20

May 2012



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Proposed Sampling Layout for Surface Sediment Sampling in the Canal

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Figure 21

May 2012